ERIC Document Resume	See Instruction Sheet	DATE OF RESUME 7/30/65	DATE RECEIVED

A. PUBLICATION DATA

1. ERIC NUMBER ED002333
2. ORIGINATOR CONTROL NO(S). N.A.
3. IDENTIFICATION NO. Report No.5

DO NOT WRITE IN SPACE BELOW

MICROFILM COPY AVAILABLE YES ☒ NO ☐

COPYRIGHT GRANTED YES ☐ NO ☒

COPYRIGHT RELEASE FILED YES ☐ NO ☐

TYPE OF REPORT
- PROPOSAL ☐
- IN-PROGRESS ☐
- FINAL ☐
- FOLLOW-UP ☐

OTHER ERIC REFERENCES:

ERIC SATELLITE CODE

4. AUTHOR(S): Riouz, Dr. J. William

5. TITLE OF DOCUMENT ABSTRACTED: The Report of a Study: The Improvement of Teaching Through the Utilization of Classroom Research in Secondary Schools

6. PUBLICATION TITLE: N.A.

7. EDITOR(S): N.A.

8. PLACE OF ORIGIN
ORG Jefferson County Public Schools
ST.
CITY, STATE Lakewood, Colorado
TELE. EXT.
INST/LOC CODE

9. PUBLISHER OR SOURCE
Jefferson County Public Schools
Lakewood, Colorado

10. VOL.	11. PAGES	12. MO./YR.	13. TOTAL PP.
N.A.	N.A.	July 1962	160

B. INDEXING DATA

14. SUBJECT AREA

15. TYPE OF ENDEAVOR Report

16. INDEXING TERMS (6-12)

curriculum research	classroom research			
methods research	school improvement			
material research	secondary schools			

17. ABSTRACT (MAX. 250 WORDS)

The project is designed to encourage and direct teachers in the use of uncomplicated scientific research, related to classwork, for the purpose of improving instruction. Teachers in Jefferson County Secondary Schools were selected at random to constitute an experimental group. They planned individual research projects with the aid of the supervisor. Project areas were testing, curriculum, use of material, and use of personnel. The important element was considered to be teacher involvement in the activity. The control group was picked from teachers in Jefferson County in terms of factors which matched them with the experimental group.

Supervisory personnel and resource personnel attended orientation activities to familiarize themselves with the projects. Supervisors worked closely with project teachers and investigated their progress. A group of fifteen projects were selected by a screening committee to receive operating funds from the Fels Foundation.

After the first year several improvements in the program were made. More careful screening by administrative groups provided opportunities for more participants. It was clear to the director of research that teachers were in need of more guidance in terms of research procedures, problem solving, and the nature of reports on projects. The personal contact with teachers was increased and more written guidelines were established.

ERIC No.

18. SOURCE OF ABSTRACT

C. FUNDING DATA

19. SUPPORTING ORGANIZATION

20. DIVISION OR DEPT.

21. CONTRACT NO.

PROJECT NO.

22. TOTAL COST OF PROJECT

23. DURATION OR PROJECT

U.S. Department of Health, Education, and Welfare
Office of Education

ERIC Form 1

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Office of Education

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THE REPORT OF A STUDY

THE IMPROVEMENT OF TEACHING THROUGH THE UTILIZATION OF CLASSROOM RESEARCH IN SECONDARY SCHOOLS

Conducted in
The Jefferson County Public Schools
Lakewood, Colorado

Dr. Forbes Bottomly, Superintendent of Schools
Dr. Delbert Peterson, Assistant Superintendent,
Instruction and Administration

With the Assistance of
The Joseph Fels Foundation, Inc.

Reported by

Dr. J. William Rioux, Director of Research and Planning

July, 1962

Department of Research and Planning
Report No. 5

ED002333

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Introduction
1960-1962

In December, 1959, the administration of the Jefferson County Public Schools submitted a research proposal to the Joseph Fels Foundation entitled, "The Improvement of Teaching Through the Utilization of Classroom Research in Secondary Schools." Financial support was sought for this research from the Foundation. The research undertaking is described briefly as follows:

Problem: The project is designed to encourage and direct teachers in the use of uncomplicated scientific research related to classwork for the purpose of improving instruction. Generally, secondary school teachers do not have the knowledge, interest, or inclination to set up and carry through projects within the framework of their own subject area needs.

Purpose: An educational program can improve only as teachers develop better ability to instruct. It is the purpose of this project to assist teachers in implementing their own development through personal participation in research which they have planned and conducted in connection with the actual teaching function.

Method: Teachers in the Jefferson County Secondary Schools will be selected at random to constitute the experimental group. Individual research projects will be planned by them with the aid of the supervisor. These can be in the areas of testing, curriculum, use of material, use of personnel or others. The important element will be the teachers' involvement in actual study. The control group will be selected from Jefferson County teachers in terms of factors which match them with the experimental group. The variable will be participation in classroom research. The data will be collected by use of achievement tests for pupils and by other instruments designed to measure the improvement of the teachers. Judgments and evaluations will be derived from reports, conferences, and visitations. These will be compiled, summarized, and interpreted.

Duration: The proposed time limitation is two years, from July 1, 1960 to June 30, 1962 with an analysis each year and an over-all evaluation. These results will be reported. Some revision and extension of the proposal procedures will be likely at the end of the first and second years.

Budget: The proposed budget represents the financial implementation of a full-fledged research program which will include continuous intensive classroom research by twenty-five or more teachers. Each item is carefully considered to provide materials, service, and supervision which will secure maximum results in terms of improvement of teaching. The proposed budget represents the funds required for the project in addition to the provision by Jefferson County Public Schools for administrative staff services, resource personnel, instructional supplies and equipment, use of the test scoring machine and business machines, and other expenses.

Following the submission of the proposal, extensive correspondence between the Director of Research of the Jefferson County Schools and the personnel of the Joseph Fels Foundation followed in order to clarify the proposal and to satisfy requests for additional information needed by the Foundation to adequately consider the basic factors involved. On June 10, 1960, word was received from the Foundation indicating that a financially modified form of the proposal had been approved, and directed the school district to proceed with plans.

1960-61

Action was taken during the summer of 1960 to familiarize and orient resource, supervisory persons on the staff of the Jefferson County Schools to the project. Resource personnel in the areas of curriculum, guidance, audio-visual aids, secondary education, and foreign languages were included in these orientation sessions. These supervisory personnel were encouraged to talk in considerable detail with teachers for whom they were responsible about the fact that it would be possible to give financial support to carefully considered and carefully evolved research undertakings in a variety of specializations. It was understood that some of the investigations would proceed throughout the school year, that others might very well be included in a shorter period of time, and that, in some instances, the projects would be carried on beyond a single school year.

A screening committee for proposed projects was established consisting of the Supervisor of Senior High Schools, the Supervisor of Audio-Visual Aids, the Supervisor of Foreign Languages, the Supervisor of Senior High Science, and the Director of Research. Of paramount importance in considering the projects were the factors of teacher initiation of these projects, professional competence, and teacher motivation which appeared to be of sufficient strength to carry a person through under supervision, to completion. From the period which began with the opening of school in September through approximately the first of November, some 20 projects were brought forward in written form for consideration by the committee. Fifteen of these developed to the point of being put into writing in proposal form by the teacher in sufficient detail that serious evaluation of the potential of the project and of the teacher to carry it out were possible. One project was rejected on the basis of the fact that the basic intent of the person making the proposal appeared to be to receive support for a patent search on an educational invention to improve the understanding of grammar. Two other projects were withdrawn before any support from Foundation funds was forthcoming because the request to copyright the project in the name of the initiator was denied. An extensive report of the first year of the program was submitted to the Foundation.

1961-62

The first year of implementation of the research project financially supported by the Fels Foundation resulted in valuable experience which was incorporated into the administration and conduct of the program during the second year. For example, it was clear at the conclusion of the first year that careful screening of research proposals submitted by teachers could result in support of a larger number of individual research undertakings. This conclusion became a matter of operating fact when it is considered that during the first year ten teachers projects involving thirty-three professional personnel were approved as compared with twenty-three research projects involving fourty-four professional personnel approved during the 1961-62 school year.

Second, the composition of the committee which served as a source of final screening for proposed teacher projects was altered. The Superintendent's Cabinet, which included the Superintendent of Schools, Assistant Superintendents for Instruction and Administration, Business Services, Personnel, and the Special Assistant to the Superintendent served as a sounding board and final decision body in relation to the projects accepted for support. In the previous year Supervisors in speciality areas functioned as a committee for the same purpose. It was felt that personnel in higher level administrative positions with a broader view of total school system operation could render more pertinent judgments in relation to research proposed.

Lastly, after the first year of operation, it was clear to the Director of Research that teachers were in need of more guidance in terms of research procedures, overcoming problems, and the nature of reports on projects. The personal contact with teachers was increased and more guidelines in the form of written materials were established.

The nature of each teacher initiated project and the evaluation of the project is contained in the material that follows. In an effort to remain true to the original intent of the research proposal submitted to the Fels Foundation and the spirit in which the grant was made, the reports are made in the language of the teachers involved.

RESEARCH PROJECTS
DESCRIPTION - EVALUATION

PROJECT TITLE A Study of the Educational Value of an Electrical Teaching Aid

Chester Cromwell

Two years of effort have gone into the subject of this study. The first year was spent in the development of an electrical device which would increase the communication level between a classroom instructor and his students. A report on this developmental period of the instrument was submitted a year ago.

During the first semester of the 1961-1962 school year the instrument was used in a ninth grade general science course by the author in order to refine the mechanical and electrical operation. During the second semester of this year, the device was used to study its effectiveness as an educational tool.

STATEMENT OF THE PROBLEM

It is the purpose of this paper to present the evidence gathered during the second semester of the 1961-1962 school year in an effort to answer the question: Does use of the instrument (hereafter called the Ed Tester) measureably increase the knowledge students derive from a ninth grade general science course?

The aim of this study has been to investigate the problem in a cursory manner. From this preliminary endeavor evidence might be gained to support an intensive research of the problem during the next school year.

Description of the Instrument and its Operation

The Ed Tester is comprised of two component assemblies and interconnecting cables. An Instructor's Console is the main electrical unit of the system, housing the instructor's control switches, student response lights, student error counters, and the electrical apparatus to perform necessary circuit requirements. A series of interconnecting cables serves to connect the Instructor's Console to Student Answer Boxes which are located on each student desk.

The Instructor's Console presents to the instructor a panel of student response lights arranged in pairs of red and green indicator lights that conform to the seating arrangement of the classroom. A printed seating chart of the student's desks and names is placed over the panel permitting the green or red light to show through the chart indicating to the instructor the progress of each student. A panel of electrically accuated counters is housed in the Instructor's Console to provide a cumulative record of the errors performed by each student in the class. A set of five master key selectors is arranged to permit the instructor to easily program the system during its operation in class.

The Student Answer Box presents the student at each desk with a selector switch with which to register his response to the instructor's questions, and a red and green pair of indicator lights to inform him of the correctness or incorrectness of his response.

In operation the instrument is used as follows: At any point at which the classroom instructor desires to check the comprehension of each student in his class he directs some form of multiple choice question to the group. True - False, matching, agree or disagree, or regular multiple choice questions may be used, the range of possible responses being limited to five items. As the question is presented to the class the instructor manipulates the master key selectors on the Instructor's Console to properly program the instrument. As each student selects his response a red or green light operates on his answer box and behind his name on the Instructor's Console seating chart panel to inform the student and the instructor of the quality of the response. At the discretion of the instructor errors committed by students can be recorded on the individual student error counters.

Hypotheses

The utilization of the Ed Tester in a classroom teaching situation during the first semester of the 1961-1962 school year and familiarity with the literature of programmed learning provided observations upon which to base the following hypotheses:

1. Use of the Ed Tester in a class in which subject matter is taught will induce greater student participation physically and mentally.

2. Use of the Ed Tester in a class in which subject matter is taught provides the student with immediate reinforcement of his correct response to each question from the instructor with a resulting increase of subject matter knowledge.

3. Use of the Ed Tester in a class in which subject matter is taught enables students to find an immediate correction to their incorrect responses.

4. Use of the Ed Tester in a class in which subject matter is taught and in which a continuous record of student errors in recorded will motivate the student to work more conscientiously in class and to prepare for classwork more thoroughly out of class.

5. Use of the Ed Tester in a class will provide greater reinforcement of success experiences with a resulting greater interest in the subject and appreciation of the course.

6. Use of the Ed Tester will encourage the instructor to more effectively program class presentations into organized bits of information which build to more encompassing concepts resulting in an increase of student understanding.

7. Use of the Ed Tester in a class will reduce the instructor's task of grading a large volume of student papers thus resulting in more time for class preparation.

8. Use of the Ed Tester by an instructor when presenting new subject matter provides feed-back to the instructor informing him when it is necessary to dwell further upon a point to clarify student understanding and when to progress to the next step.

9. Use of the Ed Tester in class will provide the instructor with a continuous indication of student performance enabling him to guide superior students into advanced work and low performance students into remedial work thus increasing the subject matter knowledge of both low and high performance students.

10. Use of the Ed Tester in class will provide the student with accurate knowledge of his progress alleviating many misunderstandings at report card time thus improving student and parent relations with the instructor and the school.

11. Use of the Ed Tester in class will make it obvious to the instructor and the group of students when a few students are consistently slow and/or incorrect in responding thus introducing social pressure to motivate such students to perform at their highest level.

RESEARCH PROCEDURE

The author taught six ninth grade general science classes at Arvada Junior High School. The classes were held during the following periods: first, second (a high performance section), third, fifth, seventh, and eighth. With the exception of the second period class all classes were heterogenously grouped. Arvada Junior High School had twelve sections of ninth grade general science and only the one was grouped homogenously.

Periods three and eight were selected to make up the experimental group and periods five and seven were selected for the control group. Although there was no effort to match the groups in terms of academic ability, performance, etc., considerable effort was taken to instruct each group under as nearly the same conditions as possible except for the experimental factor, the use of the Ed Tester.

All of the author's classes were familiar with the operation and use of the device, everyone having used it for several weeks during the first semester. At the beginning of the second semester, period five and seven classes did not use the instrument at any time. It should be said that the students in these classes were quite vocal in their objections to the discontinued use of the instrument. Their role in the experiment as a control group was of course explained. No significant negative sentiments were thereafter observed.

Classroom presentations were conducted in a similar manner for both experimental and control groups. The overhead projector was used considerably. Both groups were given the same multiple choice quizzesof fifteen minutes duration each at an average rate of three per week. The experimental group used the Ed Tester for the quizzes and the control group used paper and pencil. The questions were the same and were presented orally with multiple choice selections presented via overhead projection upon a large screen at the front of the room.

During presentation of new material and review of other material control group classes were conducted in the conventional manner. Points were presented and when the instructor felt the need,questions were asked of individuals in the class as a check of their comprehension of the material.

Experimental classes were conducted in the same manner except that in place of asking individual students,the questions were mainly addressed to all members of the class via the Ed Tester with multiple choice selections projected on the screen. A follow-up questioning of individual students who were indicated by the response lights to be in error was usually undertaken. An effort was made in the experimental classes to reach an understanding of each point by all students before the instructor advanced to the next point of the lesson. This of course was impossible in the control group. The proper time to move to the next point was determined in the control classes by the usual art of teacher intuition.

FORM OF EVALUATION

At the end of the school year form Y of the Iowa Test of Educational Development was administered to both groups as a post-test. Form **X** of the same test had been given at the beginning of the year as a pre-test. Data from the two tests were analyzed for statistical trends and differences which could confirm or deny the hypotheses set forth in this study.

Intelligence quotients were obtained for nearly all students in the two groups.

Two teacher constructed tests were used at the end of the year to gain data for analysis. One test covered material presented during the first semester and the other test covered material presented during the second semester.

An opinionnaire survey was conducted at the end of the school year. Students were asked to check; agree, undecided, or disagree to numerous statements about the course and their experience with the Ed Tester. Data from this survey were analyzed to verify or nullify certain hypotheses included in the study.

Intelligence quotients of the two groups. Intelligence quotients for students in the study were taken from school permanent record cards. The most recent test data were used in cases where more than one score was recorded.

The mean score for the experimental group was 115.3 with a range of 67, a low score of 75 to a high score of 142. The mean score for the control group was 113.0 with a range of 75, a low score of 83 to a high of 148. With a difference of 2.3 points it might be expected that the experimental group would have better performance scores, although such a small difference could be insignificant.

ITED pre and post-tests. Mean scores for the control and experimental groups were computed for both pre and post-tests. The second section of the ITED test battery, test #2, background in the natural sciences, was used as a measurement of student knowledge in the area in which this study is concerned. For an indication of the student's general academic progress during the year the composite scores of the ITED were used. The mean for the pre and the post-tests for both the science background test and the composite were computed.

The data with regard to the mean performance of the experimental and control groups on the pre and post-tests are presented in Figure 1.

It will be noted that the experimental group performs better than the control group in every case. This seems consistant with its slightly higher (2.3) mean IQ score.

The difference in the experimental and control groups is not statistically significant in at least one case and likely in all four. A computation of the standard deviation of the mean and the probably error of the mean for the post science tests indicate that the difference in the experimental and control group mean scores for this test is statistically insignificant. Since the other tests involved the same number of students with the same type and general range of standard scores it would seem that the difference between the two groups is not statistically significant in any of the four cases presented in Figure 1.

Further analysis of the data obtained from the ITED scores is presented on the graph in Figure 2. The graph shows the change from pre-test to post-test of the mean scores of the control and experimental groups. It is apparent that little if any difference exists in the amount of academic growth from the pre to post-test composite scores of the experimental and the control groups. Whereas in the science background test mean scores, a difference does exist between the two groups. It has not been determined whether this difference is significant. It would seem likely that it is not.

In a graphic analysis of the individual student scores on the ITED science background tests plotted against the student's IQ a striking difference was noted between the two groups. This difference can be observed by a comparison of the material on Figures 3 and 4. It becomes obvious after a brief inspection of the two scattergrams that a number of students in the control group made a lower score on the post-test than on the pre-test. This is of interest and will be interpreted later in the report. The scattergrams do not seem to indicate a relationship between IQ and gain in performance on the ITED science tests. A simple relationship does seem to exist between IQ and individual performance on the science test scores.

Figure 5 reflects data which dramatically exposes the considerable degree of regression in the scores of four students in the control group. It is refreshing to their instructor and enlightening to this study to note that all four of these individuals regressed similarly in the other subject matter sections of the ITED. The presence of their scores has certainly skewed the statistical complexion of the control group.

FIGURE 1

COMPARISON OF STANDARD SCORES OF ITED SHOWING MEAN SCORES OF THE EXPERIMENTAL AND CONTROL GROUPS

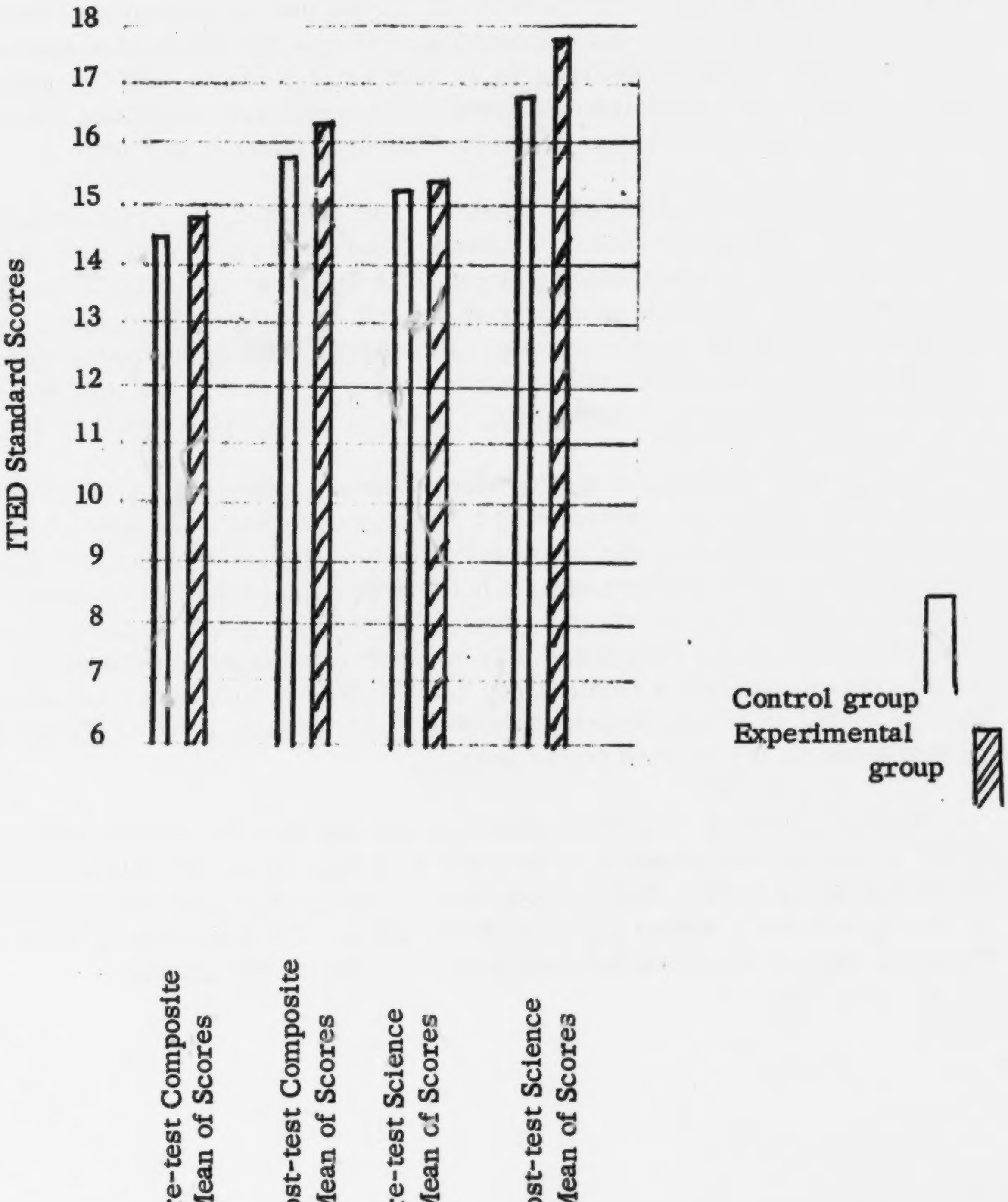


FIGURE 2

COMPARISON OF DIFFERENCE IN ITED MEAN STANDARD SCORES OF THE EXPERIMENTAL AND CONTROL GROUPS SHOWING CHANGE FROM PRE- TO POST-TEST PERFORMANCE

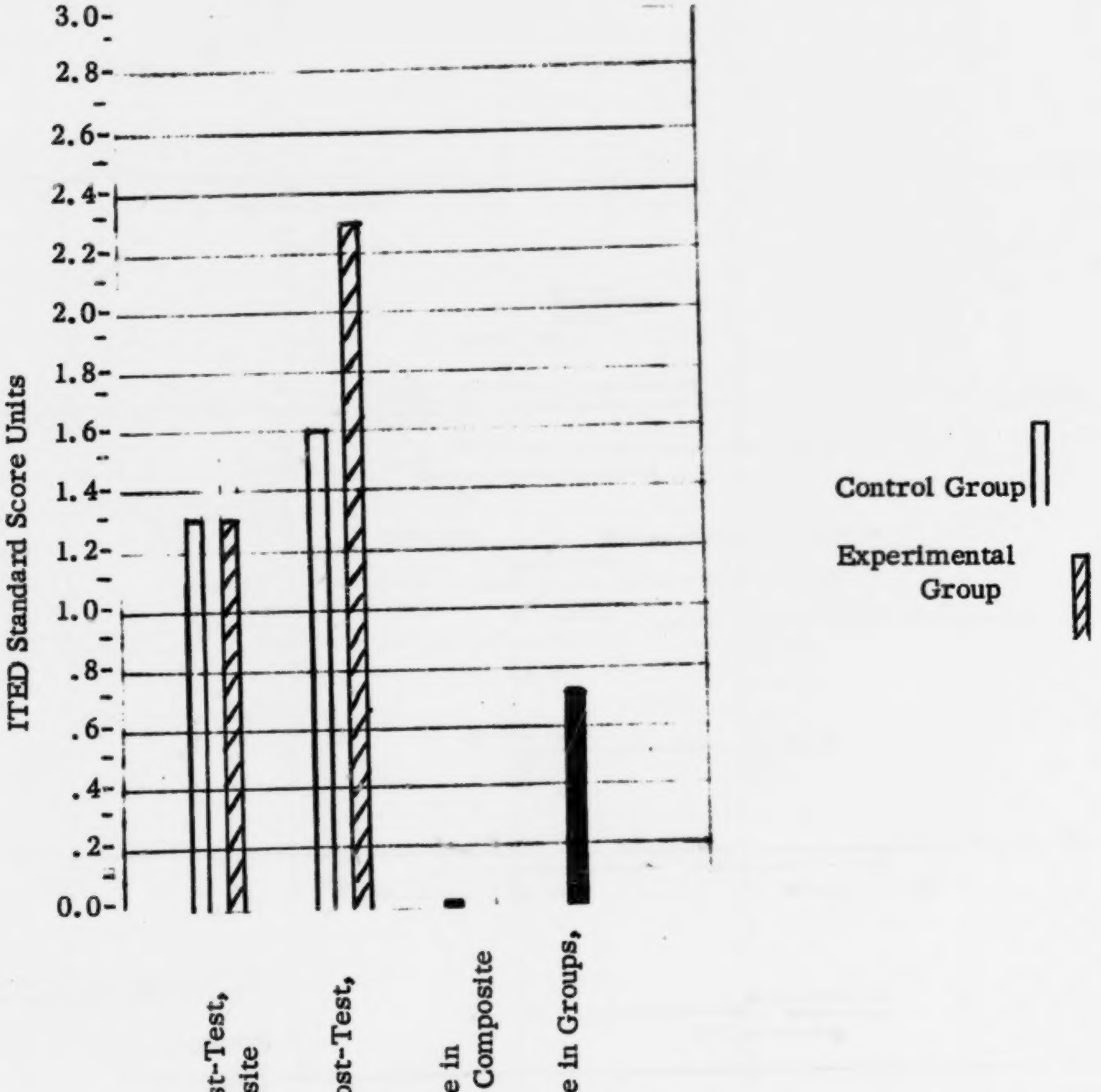


FIGURE 3

SCATTERGRAM PLOTTING IQ AND ITED STANDARD SCORES FOR PRE- AND POST-TEST SCIENCE SECTION

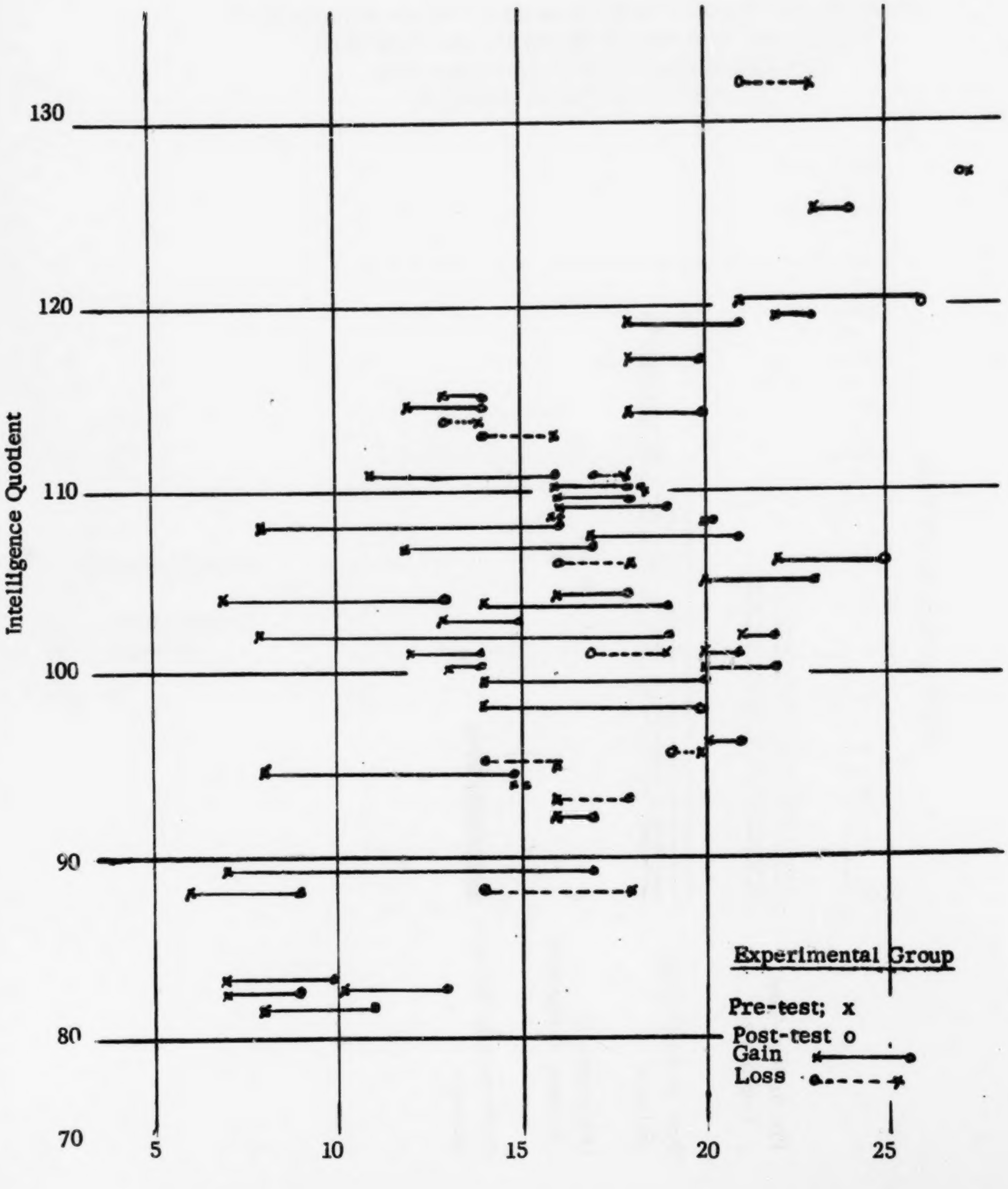


FIGURE 4

SCATTERGRAM PLOTTING IQ AND ITED STANDARD SCORES
FOR PRE- AND POST-TEST

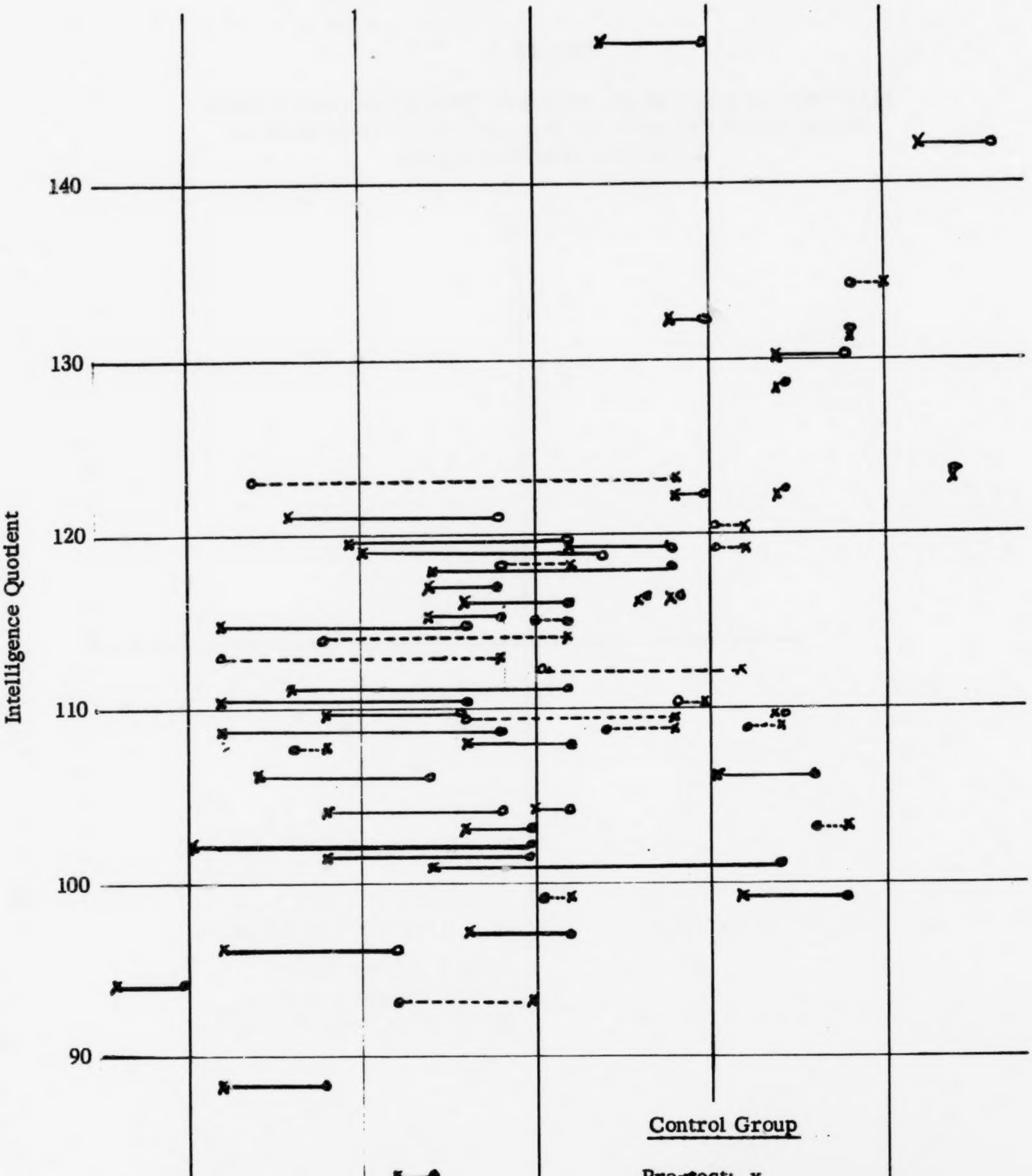
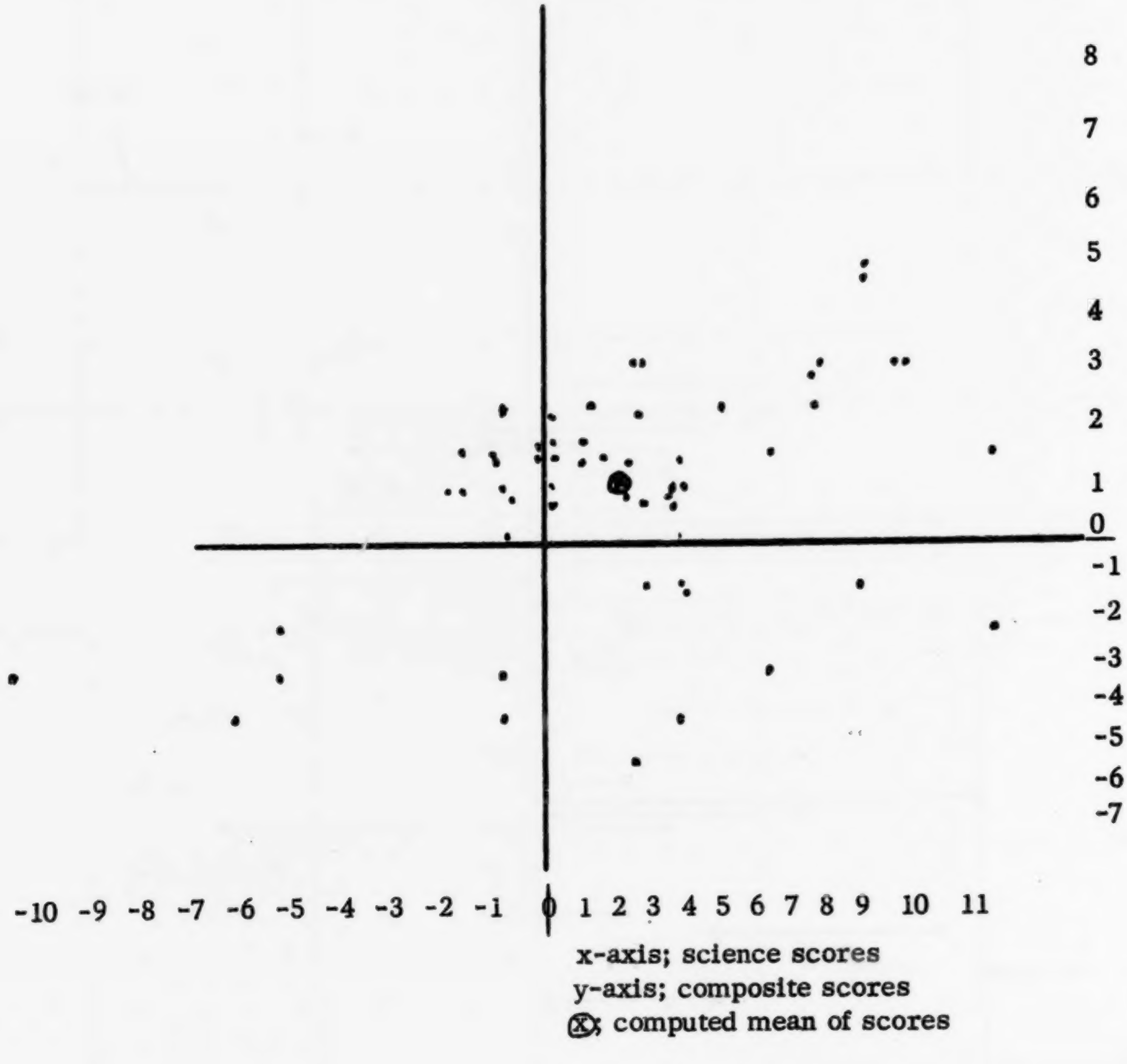


FIGURE 5

PLOTTING OF INDIVIDUAL STUDENT ITED STANDARD SCORES SHOWING DIFFERENCE IN PRE- AND POST-TEST SCORES FOR THE CONTROL GROUP



Teacher constructed tests. Two rather comprehensive tests each requiring a full class period to administer were given to each group at the close of the second semester. Test 1 covered course material presented during the first semester when neither group had the exclusive use of the Ed Tester. For that matter the machine was used very little during the time most of the material on the test was presented. Results of the test are presented on Figure 7.

Test 2 covered material that was presented during the second semester, the period that the Ed Tester was being used in the experimental study. The data resulting from this test is also presented on Figure 7. It is of importance to recognize that the range of Test 2 is approximately double that of Test 1. The difference between the control and experimental group mean scores is also approximately twice as much in Test 2 as in Test 1.

Student opinion survey. An objective survey of student opinion was conducted at the close of school. Of the forty-four statements in the opionnaire only fourteen have bearing on this report. Students were asked to check each statement in terms of agreement, undecided, or disagreement. The items of interest are repeated below with the student response for the experimental and control (when applicable) groups listed in terms of percents.

1. I would rate my science class as about the most worthwhile class I have during the day.
   Agree 42% Undecided 31% Disagree 27% (Experimental)
   " 30% " 40% " 30% (Control)

2. This year science has been very interesting.
   Agree 88% Undecided 7% Disagree 5% (Experimental)
   " 73% " 10% " 17% (Control)

3. I feel that I have learned less this year than in other science classes.
   Agree 5% Undecided 0% Disagree 95% (Experimental)
   " 5% " 5% " 90% (Control)

4. I believe the Student Answer Boxes (hereafter the SAB) speeded class progress.
   Agree 89% Undecided 11% Disagree 0% (Experimental)

5. Whether the instructor knows I am thinking correctly or incorrectly has very little to do with the way I work in class.
   Agree 4% Undecided 24% Disagree 72% (Experimental)

6. I seldom found out the correct idea after I found that I had been in error in class this year.
Agree 3% Undecided 3% Disagree 94% (Experimental)
" 8% " 25% " 67% (Control)

7. The SAB were not used enough this year. I feel that I really learned more when using them that during other types of class activity.
Agree 72% Undecided 15% Disagree 13% (Experimental)
" 47% " 29% " 24% (Control)

8. When I knew that a Quiz would be given the next day on the SAB I generally tended to prepare a little better than for regular paper-pencil type quizzes.
Agree 42% Undecided 10% Disagree 48% (Experimental)

9. Class periods involving the SAB have been more interesting this year than other class periods in this room.
Agree 81% Undecided 12% Disagree 7% (Experimental)

10. The best use of the SAB equipment seem to have been when the instructor was using it rather informally without a written list of questions.
Agree 60% Undecided 18% Disagree 22% (Experimental)

11. The most important part of the SAB equipment is its ability to keep a record of the errors students make in class.
Agree 31% Undecided 26% Disagree 43% (Experimental)

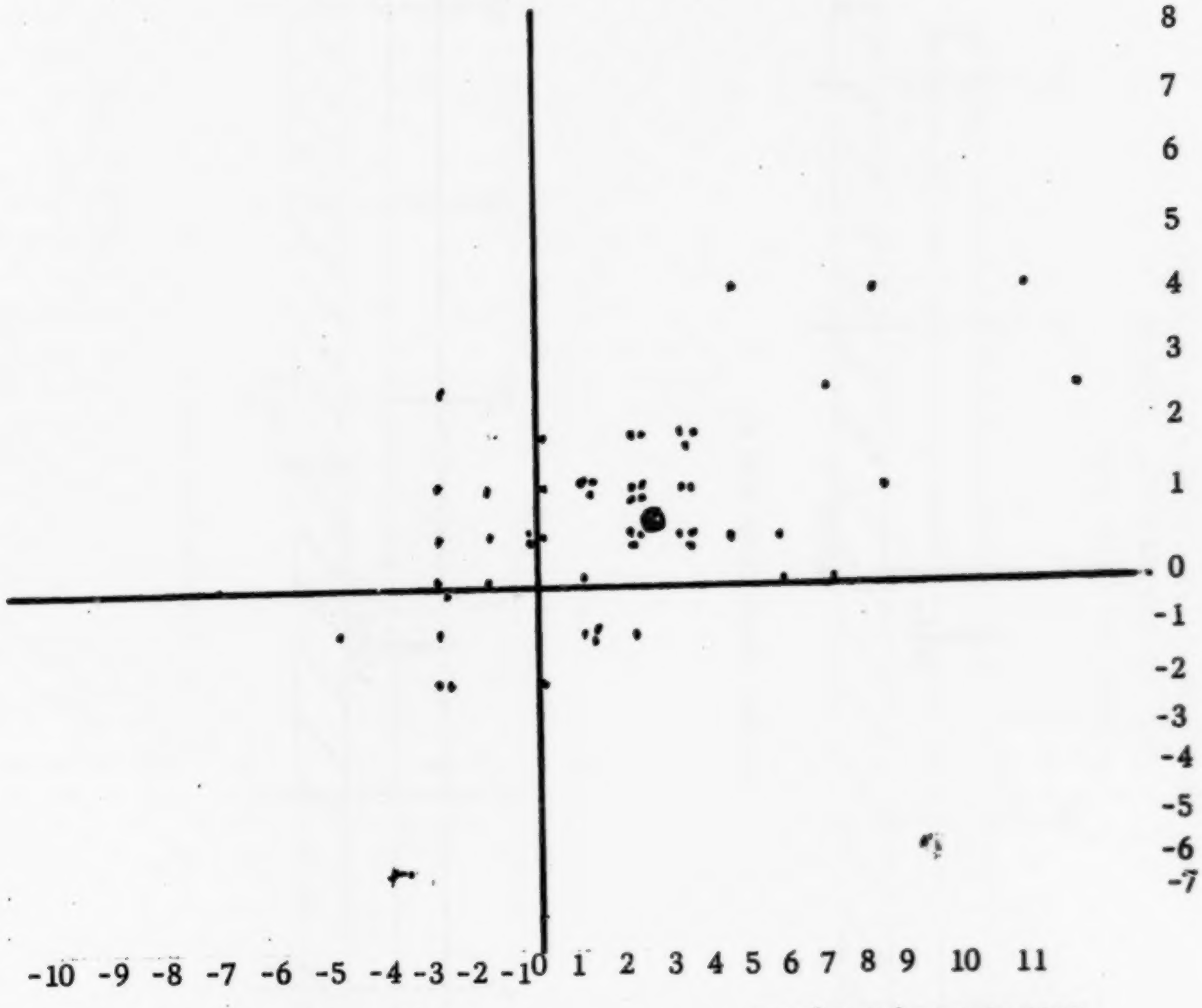
12. Being frankly honest, I feel that I could learn more without the SAB if only the instructor could keep my attention.
Agree 11% Undecided 26% Disagree 82% (Experimental)

13. As for improving the learning situation in school I believe the SAB idea is well worth spending more time and money in developing and refining the equipment and its use in teaching.
Agree 88% Undecided 5% Disagree 7% (Experimental)

14. I believe that the SAB idea is OK but I feel that the school tax money might be spent to better advantage on other research projects.
Agree 2% Undecided 29% Disagree 69% (Experimental)

FIGURE 6

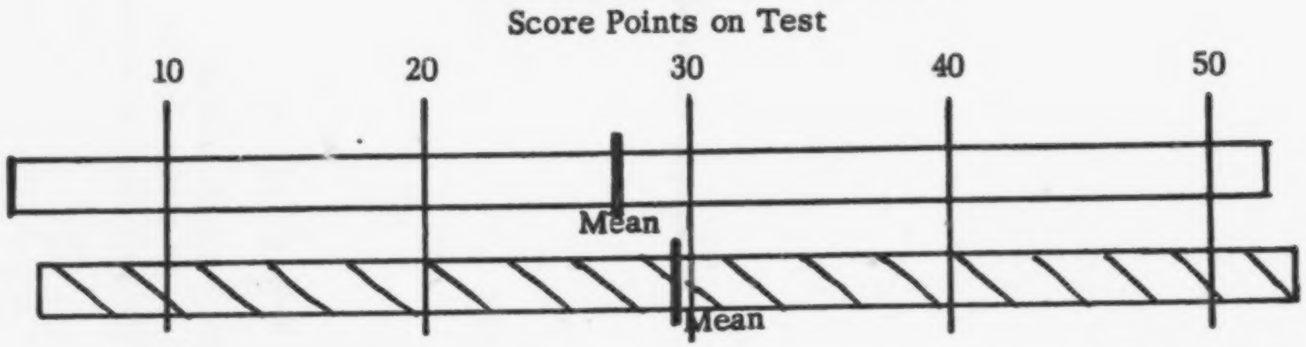
PLOTTING OF INDIVIDUAL STUDENT ITED STANDARD SCORES
SHOWING DIFFERENCE IN PRE- AND POST-TEST SCORES
FOR THE EXPERIMENTAL GROUP



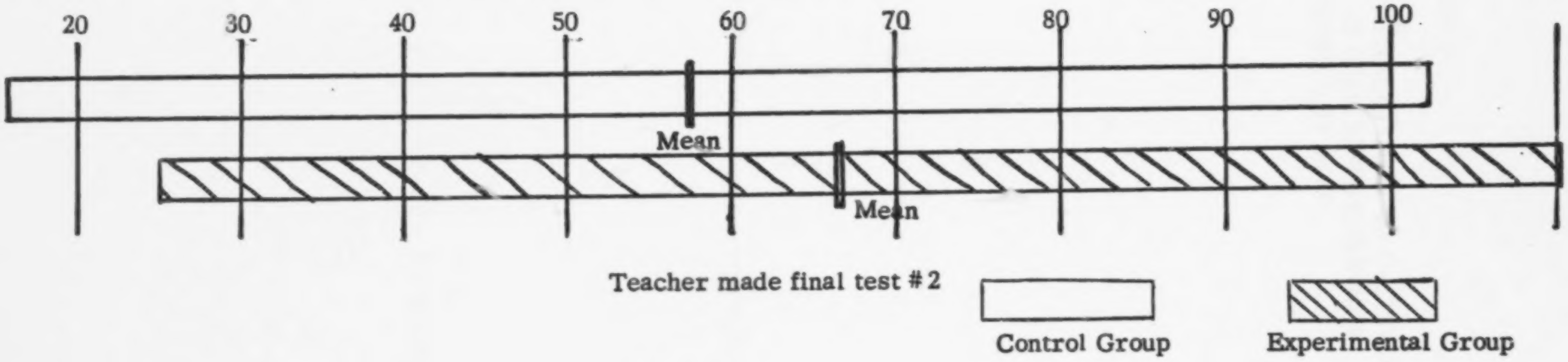
x-axis; science scores
y-axis; composite scores
⊗ computed mean of scores

FIGURE 7

GRAPHS SHOWING MEAN SCORES AND RANGE OF SCORES
ON TEACHER MADE TESTS FOR CONTROL
AND EXPERIMENTAL GROUPS



Teacher made final test #1



Teacher made final test #2

Students were not required to sign their names to the sheets upon which they made their response to this opinionnaire. No attempts were made to identify the opinions of individual students.

During the last class period of the year, students in the second period advanced class who had used the Ed Tester as much as the experimental group and the students in the third period class were asked to write a short statement in which they were to explain whether they would prefer to be in a class next year that used the Ed Tester or in a class which did not use it. The students were asked to briefly state why they answered as they did. Results of these comments are summarized on Table I.

It seemed desirable to gain student opinion from a group which had not been under the direct instruction of the author, but who had used the Ed Tester in class. A teacher of eighth grade science had used the equipment several times during the year with her class. This class was asked to comment on the same topic described in the above paragraph. The data from the response of this class is also included on Table I.

STUDENT COMMENT AND REASONS	Advanced Class	Experimental Class	Other Instructor's Class
Would like a class with Ed Tester next year			
Yes	26	25	16
No	3	0	0
Learn more	9	8	3
Learning easier	4	4	4
More interesting	4	4	4
Greater understanding	6	9	1
Faster progress	6	1	0
Greater participation	2	0	0
Better teacher-pupil contact	3	1	0
Make better grades	1	0	0
Better retention of material	0	2	0
Makes one work harder	0	2	0
Builds confidence	0	1	0
Others can't cheat	0	2	2

TABLE 1
SUMMARY OF DATA OBTAINED LAST DAY OF
SCHOOL REGARDING STUDENT
ATTITUDES ON
ED TESTER

Interpretations of Results of the Study

Test Results Very little, if any, significant difference appears between the control and the experimental group when one examines the mean of the scores of the pre and post-test ITED results. It is very probable that the test items in the background in the natural science section of this test do not adequately reflect a valid sampling of the ninth grade general science course content. The differences in the mean scores as presented on Figure 1 are quite probably due to the difference in the mean IQ of the two groups or due simply to chance.

The analysis of the same basic data as presented on Figure 2 may indicate more significant differences in the science background growth of the experimental and control groups. If this difference is significant it would seem that the difference between the two groups is not necessarily due to their difference in mean IQ ratings. The data on Figure 2 seems to be the best supporting evidence from the ITED results suggesting that use of the Ed Tester will increase the knowledge gained by students over that gained by disuse of the instrument.

It is difficult for the author, as instructor of the control group, to interpret the rather large number of receding scores reflected on Figure 3. It seems difficult to accept the possibility that the seventeen students who made lower standard scores on the post-test than on the pre-test actually lost science background knowledge during the school year.

After cross-checking these individuals against the data reflected on Figure 5 it seems that approximately 1/3 of these individuals also made lower scores on the post-test composite score than on the pre-test composite scores. This still leaves a large section of the control group who clearly performed at a lower level at the end of the year on the science test.

The prejudiced view of the author would explain this fact in a way that would not cast negative reflections on the instruction received by the control group. It is certainly a possibility that more members of the control group than the experimental were less motivated to do their best on the science background section of the ITED post-test. This interpretation is justified in part by the opinionnaire study, items 1 and 2. A larger percentage of the control group felt science was not their most worthwhile subject and that it was not "very interesting."

It is a fact that the ITED was administered in somewhat unfavorable circumstances both Spring and Fall periods. If a difference in motivation existed from one time to another the test scores would certainly reflect this factor. An analysis of data on Figures 5 and 6 indicates that twenty-one percent of the students performed at a lower level on the post-test than on the pre-test composite score. In summarizing this point of view it would seem that motivation may have been an important causative factor in respect to differences in the ITED mean scores.

Inspection of the scores from the teacher constructed tests given at the completion of the course does not reveal an important difference in the knowledge gained or retained in the two groups. There is a small difference in the mean scores but this again may be only a reflection of the slight difference in the mean IQ of the two groups. More justification seems to exist to state that the test data presented on Figure 7 only denies the hypothesis that the experimental group profited more knowledge wise from their use of the Ed Tester.

If this study has discovered little measurable difference in the knowledge gained between the two groups as a result of the Ed Tester at least it has produced clear and strong support for several other hypotheses listed at the beginning of this report. The support comes from the student opinion survey. Items 1, 2, and 6 of the survey show a distinct difference of opinion in the control and experimental groups. This difference in opinion supports hypothesis five and hypothesis three to some degree.

It is interesting to note in particular item seven on the opinionnaire. The strong agreement of the experimental group and the weak agreement of the control group to the idea that the Ed Tester assists in the learning process could mean that the logic of the device convinces some students of its value but continued use of the instrument in class increases the number of students who are convinced of its value in the learning process.

Items 9, 12, 13, and 14 of the opinionnaire lend strong support to the continued research and development of the Ed Tester. The same support is found in the tabulation of student statements presented on Table I. Student attitude toward this device and its use in class has been sustained at a high supporting level from the first day of its use until the last.

CONCLUSIONS

The purpose of this paper has been to present the evidence gathered during the school year in an effort to answer the question: Does use of the Ed Tester measurably increase the knowledge students derive from a ninth grade general science course? The study has been cursory in scope and depth. The conclusions drawn here will determine whether research will be continued on this project and if so, in what direction.

Eleven hypotheses were set forth in the beginning of this report. It must be admitted that research plans and activities were not effectively directed toward adequate testing of all hypotheses. If research is conducted on this project next year it would be necessary to sharply clarify a limited number of the hypotheses and devise research procedures which would produce results offering greater confirmation or denial of a given hypothesis.

Results of this year's study, especially from the opinion survey, seem to support the following hypotheses:

1. Use of the Ed Tester in a class in which subject matter is presented will induce greater student participation.

2. Use of the Ed Tester in a class in which subject matter is presented will enable students to find an immediate correction to their incorrect responses.

3. Use of the Ed Tester in a class will provide greater reinforcement of success experiences with a resulting greater increase in interest and appreciation of the course.

4. Use of the Ed Tester provides feed-back to the instructor informing him when it is necessary to dwell further upon a point to clarify student understanding and when to progress to the next step of instruction, thus increasing instructional efficiency.

The following hypothesis seems to be denied from the evidence collected:

1. Use of the Ed Tester in a class in which subject matter is taught provides a continuous record of student errors and motivates students to work more conscientiously in class and to prepare themselves out of class.

The remaining hypotheses of this study have not been given adequate testing and no conclusion can be drawn about them.

In summary it seems clear that the only important results of the educational research on the Ed Tester this year are found in the survey of student opinion. This opinion strongly supports continued research and development on the project. If significant increases in the efficiency of the instructor or in the efficiency of the learner using the Ed Tester are actually produced, such differences have not been clearly established by this study. If the Ed Tester produces such desired results as increased learning it seems obvious that more elaborate plans must be laid to expose the results. The hypothesis that this device will increase the level of student knowledge seems to remain worthy of investigation in the opinion of the author. The author is eager to conduct a more sophisticated research of this problem next year.

PROJECT TITLE Tape Teaching for Slow Learners

Stuart Brown, Glen Luchau

STATEMENT OF THE PROBLEM

To determine whether utilization of pre-recorded tapes will permit better provisions according to instructional need for pupils in an improvement class.

Hypothesis

Utilization of pre-recorded tapes will result in more improvement and greater achievement on the part of slow learners than slow learning students taught in the conventional manner without this form of assistance.

RESEARCH PROCEDURE

A Language Arts Improvement group will be selected at Manning Junior High School as an experimental group and a control group will be designated.

Pre-recorded experience will be presented from tape to small groups and individuals according to their needs. Two approaches are suggested:

a. Play the recorder in a corner of the room and group selected pupils around the machine.

Disadvantages: Slow learners are easily distracted. Playing the recorder in the classroom might interfere with the work of other pupils not involved directly with the recording.

b. Establish a means by which the recorder may be heard only by the pupils directly involved. This can be accomplished by the use of earphones. This would require from 5 to 10 headsets.

The tapes would be concerned with the repetitive drill and experiences that the slow learner requires so much and which ordinarily take so much teacher time.

FORM OF EVALUATION

Pre and post-testing of students to assess degree of educational progress over the period of one school year utilizing the tape teaching approach to instruction of students with learning difficulties .

PROGRESS REPORT

Due to
1. the lack of classroom space as the result of an increased enrollment,
2. the delay in the completion of the building addition,

it was impossible to complete the installation of the laboratory equipment until the end of the final quarter. The laboratory is now ready for use and the project will definitely begin in September 1962 with the following program:

1. Remedial Seventh Grade Language Arts
2. Ninth Grade General Mathematics (remedial)

These two groups will be taught primarily by the tape teaching technique.

3. Groups of students in average sections will make use of the laboratory as they reveal weaknesses in areas of academic subjects.

PROJECT TITLE Classroom Research in the Field of Laboratory Equipment in Mathematics

Marvin Karlin, Alice H. Shaw, Camille Smith

STATEMENT OF THE PROBLEM

To develop practical, yet imaginative laboratory equipment for use in junior high mathematics classes on the premise that such equipment will reinforce and facilitate the acquisition of mathematical concepts and results in increased learning by students.

RESEARCH PROCEDURE

In view of the broad area covered by the title, it was decided to delimit the scope to the following areas:

I. The Abacus
II. Logic
III. Pentominoes
IV. Dominoes
V. The Metric System

Examples of several units are included at the end of this report.

It was the original purpose in September, 1960, to be able to prepare units of study on each of the above topics which could be used, with variations, in the intermediate grades and junior high school.

It goes without saying that mathematics is in dire need of laboratory equipment to illustrate mathematical concepts and principles. The laboratory sciences have used equipment successfully in classroom instruction for a considerable number of years. Yet mathematics, the basic tool for all science, has shockingly neglected this technique.

Therefore, the basic purpose was to try to supply ideas and materials to be used to reinforce certain mathematical concepts.

In 1960-1961, capable students under my guidance researched, wrote, and taught units on the abacus, logic, pentominoes, dominoes, and the metric system.

LOGIC - This unit was written in 1960-1961, and is an excellent start to a good, useful unit on logic written for the junior high school student. Lack of time has prevented any revision of this unit in 1961-1962. Because of the highly beneficial nature of this unit for average to advanced students of mathematics, I plan to work on this revision during the coming year, so that its content will be improved and useful to the junior high school mathematics teacher. The original content is contained herein.

DOMINOES - This unit was written in 1960-1961, and is just a beginning of an idea. The ramifications of a unit such as this are many and varied, especially for the elementary and intermediate grades. I believe recreational mathematics is too often overlooked as a substantial and enjoyable way of learning important concepts in mathematics. The original unit is contained herein.

PENTOMINOES - Rather than a unit of study, the pentominoes can be used on a bulletin board or display table. I found it to be a tremendous source of enthusiasm for students of all ages in the intermediate grades and junior high school. Besides the enthusiasm that it aroused, I felt that the pentominoe puzzles were very valuable in getting students to try to picture solutions to geometric problems. This training in visualization is very beneficial.

Two dimensional or three dimensional pentominoes are available, can be made by following the patterns illustrated in the material enclosed.

METRIC SYSTEM - A unit on the metric system was begun in 1960 and the incomplete results were published in the 1961 report. However, since the new School Mathematics Study Group materials include a unit on this subject, further research was abandoned.

ABACUS - Work during 1961-1962 was concentrated on this unit.

The original unit of approximately seventeen pages prepared in 1960-1961 was expanded and revised to a full unit of about thirty-five pages.

Along with the preparation of this unit, supplies were bought for forty wooden abacuses, which the boys in the Industrial Arts classes at Manning Junior High School made. These were made in such a way as to be used as a Chinese abacus, Japanese abacus, or for any base system up to and including twelve. It is my hope that they will be used by any Jefferson County teacher who wishes to teach a unit on the abacus.

It is my desire, along with that of the four ninth grade girls who helped prepare and revise this unit, that parts of this unit or the entire unit will be used as review work or as introductory work for units of whole numbers, decimals, and base system study.

It was the recommendation of the class used for experimentation in 1961 that this unit be taught to the average or advanced student in fourth, fifth, and sixth grades. During 1961-62, this unit, in its entirety was taught by Mrs. Camille Smith, Slater Elementary School, to her sixth grade class. Four to five weeks were taken for this unit, and the class was tested before and after the exposure. Dittoed copies of the entire unit were given to each child, as were supplies for making individual abacuses.

FORM OF EVALUATION

The following are the values which I feel can be learned by use of the abacus.

Abacus Values

Motivation - It is felt that renewed interest in mathematics can be obtained through the use of an abacus unit or the use of abacus as a diversification during skill work.

Accuracy and Speed - Although practice may not make perfect, it will, without question, breed more accuracy and speed. The practice is particularly effective when it is being done in a pleasurable and new way.

Number Relationships - I believe that the principles behind number relationships can be taught indirectly through using the abacus. In particular the associative and commutative principles of the real numbers are used, unknowingly, throughout the abacus work.

For example: In adding a column of numbers it may be more convenient and practical to add one number before another.

$13+16 = 16+13$ (Commutative)

In the problem below it is more practical for speed to add 35 and 15 first.

$27+(35+15)$ (Associative)

Numbers - Numerals - The fact that numbers can be expressed as different symbols or combination of symbols is learned early in the abacus work in order to facilitate the work.

Example: $18=10+8$, $20-2$, $10+5+3$, etc.

Place Value - I believe that the abacus is one of the greatest devices for teaching place value that exists. It re-emphasizes the decimal grouping that we often do not remember and take advantage of. As one of my students commented after studying the abacus, "You learn place value right before your eyes."

Short Cuts in Mental Computing - In working with the abacus it becomes quite obvious very soon that certain operations can not be made unless they are thought of in some other way. For instance, if the abacus reads 28, it is physically impossible to add 9 to it. Therefore the idea of adding 9 is thought of as adding 10 and subtracting 1.

We hope to prove that these and other such ideas will be carried over in the mental computing of the student.

It is obvious from the statement of these values that testing for their conception is close to impossible.

However, upon the suggestion of the Director of Research, and the Mathematics Research Supervisor, the Stanford Achievement Test, Intermediate Battery Partial, Form L was given to the sixth grade class involved before and after the unit was taught. Simultaneously, it was given to a controlled group of sixth graders, who then continued their normal pattern of mathematics.

CONCLUSIONS

I was able to come to no conclusions from the use of the tests described above. Since the class involved in the abacus work contained groups of low, and high average students, and the controlled group contained groups of average and advanced students, any hint at significant factors from the test were inconclusive.

Therefore, conclusions based on the subjective observations of both the writer and the sixth grade teacher involved in the experiment seem to be of the utmost importance.

Mrs. Smith lists several suggestions based on her observations of her sixth grade class.

1. The abacus unit should be taught in parts rather than as a unit.

   At the conclusion of the five weeks spent on the abacus, many of the students, particularly the more alert ones, were bored and had lost interest, although the interest had been great at the offset.

   Therefore it would seem advisable to teach the unit in parts. For example, the work on whole numbers could be used as a review of the whole number unit. The work on decimals could be used as an introduction or as a review to the study of decimals. And the section on various bases would seem a good introduction to the unit in the School Mathematics Study Group material in grade seven.

2. The abacus unit is of more value to the younger or slower student, and would be best taught to a more homogenous group.

   From observation is became apparent that the more alert child acquired the skills and intrinsic values more quickly, and became bored with the procedure when caused to wait for the slower student. However, the slower or younger student showed great interest and retained this interest for a longer period of time.

Ramifications

It is my opinion that the units prepared under this Fels Grant can be of great value to the mathematics or elementary school teacher; especially those units prepared on the abacus and logic. The obvious difficulty will be the dispersing of the information, and the printing of the units.

It is my suggestion, therefore, that the mathematics department be requested to make one copy of these units in their entirety available to each teacher of mathematics, and each elementary school, with the stipulation that if interest is shown in the teaching of these units, copies will be supplied for the class involved. (The printing of the logic unit should be postponed until further revision can be made on it.) The teachers should also be told that use of the wooden abacuses, presently housed at Manning Junior High School, is available to them.

I will be available for help and guidance in the teaching of these units, or the preparation of bulletin boards and displays using the material involved herein. In the meantime, I plan to continue revision of the unit on logic, so that it may also be made available.

It is with sincerest gratitude that I terminate my final report on my Fels project. Although time did not permit the conclusion of many of my plans within the two years, I will always be grateful for this long desired opportunity to engage in research with teaching devices.

Chapter I

Introduction to Logic

When a person says to you that recently a mathematician discovered a new form of Differential Calculus, or a new theorem concerning the origin of the universe, or maybe even an entirely new field of mathematics, what would you think? Probably you would imagine a little gray-haired, old man, half out of his mind, bent over an ancient desk, piled to the ceiling with papers full of equations and formulas. That, however, is not necessarily true. Many mathematicians are young men, and very few of them have taken leave of their senses. Furthermore, the desk of a modern day mathematician is hardly piled high with papers full of difficult equations or formulas. The mathematician's job is not to constantly add, subtract, multiply, carry out long division problems or do complicated algebraic computations. That is done much more quickly by large electronic computers. The mathematician is really a logical thinker, or logician.

Your minds are now probably asking, "What is logic? What does it have to do with me?" Logic is really a form of reason.

There are two main kinds of logic; deductive reasoning and inductive reasoning. When you reason by deduction you take a known general fact or principle and draw from it a specific conclusion. When you take a number of specific conclusion you are said to be reasoning by induction.

Deductive problems are frequently expressed in the form of a syllogism. Syllogisms consist of three main parts; a major premise, which states a known fact; a minor premise, which states another known fact, which is, in some way, related to the major premise; and a conclusion, which is a new fact, arrived at by deductive reasoning, concerning the relations of the major and minor premises. An example is:

Major premise - Honest men don't lie.
Minor premise - George is an honest man.
Conclusion - Therefore, George doesn't lie.

We must be careful with our conclusions, however, because some syllogisms might lead us off on the wrong track. An example is:

Major premise - Honest men don't lie.
Minor premise - George doesn't lie.
Conclusion - ?

This obviously doesn't work. But don't bother yourself with this quite yet. Just concentrate on knowing what induction is, what deduction is, and what simple syllogisms are.

The study of logi originated in the days of the ancient Romans and Greeks. Some people say Aristotle was the first logician. Others say that Roman Lull was. Both of these men, strangely enough, usually ended up with incorrect conclusions. But they gave logic its start. The most famous logical thinkers were George Boole and Francis Bacon.

Below are some simple syllogisms, without conclusions. Fill in the conclusions. If you run across a syllogism, like the second example above, where you can't state a definite conclusion explain why you can't state a specific conclusion.

1. Major premise - All men are mortal.
   Minor premise - Socrates is a man.
   Conclusion - Therefore,

2. Major premise - All dogs hate cats.
   Minor premise - Rover is a dog.
   Conclusion - Therfore,

3. Major premise - All men have heads.
   Minor premise - Mr. Carson is a man.
   Conclusion - Therefore,

4. Major premise - All even numbers are whole numbers.
   Minor premise - Two is an even number.
   Conclusion - Therefore,

5. Major premise - All forms of math are based on logic.
   Minor premise - Algebra is a form of math.
   Conclusion - Therefore,

Brainbusters

6. Major premise - All B is C.
   Minor premise - A is B.
   Conclusion - Therefore,

7. Major premise - All boys are good spellers.
   Minor premise - Alice is a good speller.
   Conclusion - Therefore,

8. Major premise - A plus B equals Y plus Z
   Minor premise - R plus S equals A plus B
   Conclusion - Therefore,

9. Major premise - All Y is Z.
   Minor premise - X is Y.
   Conclusion - Therefore,

10. Major premise - All girls have two legs.
    Minor premise - Joe has two legs.
    Conclusion - Therefore,

11. Define deductive reasoning and inductive reasoning.

12. Name the main parts of a syllogism, and explain what they represent.

13. Name some logical thinkers.

** Suggestion: Research projects on the lives and work of some of our famous logicians would make interesting reports.

Chapter 2

In the previous chapter we became familiar with some of the basic fundamentals of logic. The simple deductive syllogisms we learned to solve were comparatively easy. They can, however, become more complex. When they do, we need a simple diagram to illustrate the major and minor premises in order to find a good conclusion. When we draw diagrams to illustrate a problem, we are working with a field of mathematics known as symbolic logic.

Many methods of illustrating logical problems with diagrams have been devised. For many years a method developed by a man named Euler was considered to be the perfect method. Then, a mathematician working with inductive logic at Cambridge University discovered a new method, involving the use of intersecting circles. His name was John Venn. His method has become known as Venn diagrams or Venn circles.

After his discovery, he wrote articles for magazines, including the periodical, "Philosophical Magazine." He also wrote a series of books in which he included some chapters involving his new method.

To understand how Venn diagrams work, let us first apply them to a simple syllogism:

Major premise - All good readers use dictionaries.
Minor premise - Sally is a good reader.

The conclusion is fairly obvious, but let us suppose that we are unable to find a good conclusion, and we need Venn diagrams to help us. We will begin by drawing a circle (Figure 1.) We shall call this circle A. Circle A will represent all people who use dictionaries. According to the major premise, all good readers use dictionaries. This does not mean, however, that all people who use dictionaries are good readers. (Remember: The converse of a statement is not necessarily true!)

Therefore, the group, or set, of all good readers makes up only a part of the set of all people who use dictionaries. We will represent this by drawing a circle B inside of circle A (Figure 2).

The minor premise then states that Sally is a good reader. Therefore, Sally is a member of Group B (all good readers). We shall make a small x inside of circle B to represent Sally (Figure 3). This shows that Sally is also enclosed in circle A (all people who use dictionaries.)

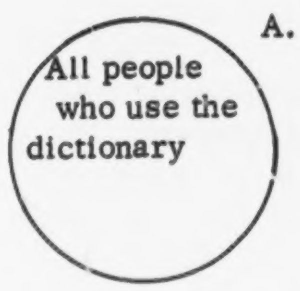


Figure 1.

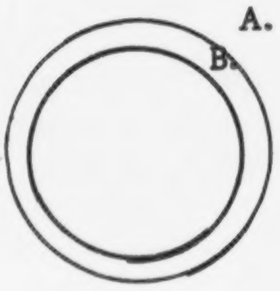


Figure 2.

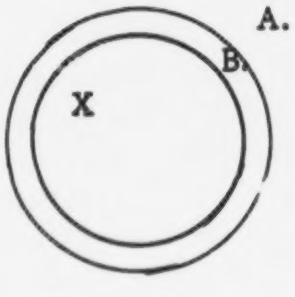


Figure 3.

Now let us try a harder problem, of a more abstract nature. Let the universe be contained in one rectangle (Figure 4). All points in this rectangle are part of the universe. Now let circles X, Y, and Z universe. (Figure 5) If point M is a member of all three groups; X, Y, and Z, where would point M be located? (See Figure 6 for the correct solution.)

Let us take another syllogism, only this time a more complex one:

Major premise - All men are mortals.
Major premise - All mortals are men.
Minor premise - Socrates is a man.
Minor premise - Aristotle is a mortal.

For the correct solution, see figure 6.

We will let circle A represent all men and circle B represent all mortals. But since our major premises stated that all men are mortals, and all mortals are men, circle A and circle B coincide (are the same circle). So here we have two different circles, one on top of the other. Let point **X** stand for Socrates; point Y stand for Aristotle. Figure 7 shows the Venn diagram illustrating our syllogism.

The conclusions are:

Conclusion 1 -∴ Socrates is a mortal.
Conclusion 2 -∴ Aristotle is a man.

(The three little dots (∴), arranged in a triangle, mean "therefore".)

Sometimes when we use Venn diagrams, we have a problem like: Point **X** is a member of group A and/or group B. Where is point **X**? In this new problem, we cannot definitely locate the position of point **X**. We must, therefore, color in the entire area where X might be found in order to be absolutely correct. (See figure 8). For this, we say: Point **X** can be found in the "union" of the two circles. "Union" means, those points found in either or both sets. The symbol for union is "U". Therefore, **X** would be found in AUB.

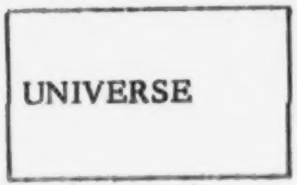


Figure 4.

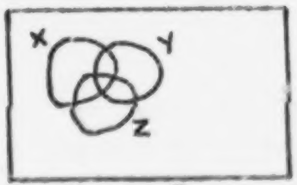


Figure 5.

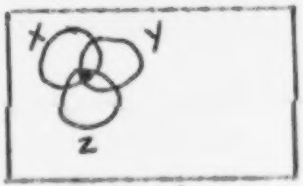


Figure 6.

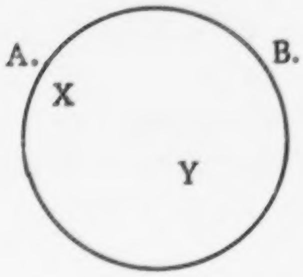


Figure 7.

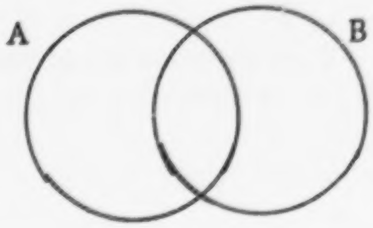


Figure 8.

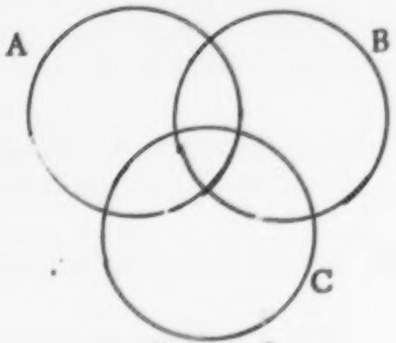


Figure 9.

Another example of this kind of problem is; point X is a member of groups A and C or groups B and C. Where is point X? (See figure 9 for the area in which X may be found.) Our answer, as to the location of point X, would be: where A and C or B and C intersect. We have a little symbol to represent "intersect". The symbol is "$\cap$". We can now write our answer as: $A \cap C$ or $B \cap C$.

If, for some reason, we want to say where a point is NOT found, we use the sumbol "$\sim$". This means "not contained in."

Now, with your background knowledge of Venn diagrams, you should be able to use them to solve problems of your own. Following are some problems for you to work out. Supply an answer or a conclusion to each problem. Also draw the Venn diagram that you used to solve the problem. Remember, be sure to show what each Venn circle represents. In your answers, use the signs $\therefore$, $\cap$, $\cup$, and $\sim$ when needed.

1. Major premise - All Russians are Communists.
   Minor premise - Vladimir is a Russian.
   Conclusion - ?

2. A, B, and C are groups of people living in the United States. X is a member of all three groups. Where is X located?

3. Major premise - All boys can run.
   Minor premise - Lynn can run.
   Conclusion - ?

4. Major premise - All dogs are canine.
   Major premise 2 - All canines are dogs.
   Minor premise - Susie is a canine.
   Minor premise 2 - Tuffy is a dog.
   Conclusion 1 -?
   Conclusion 2 -?

5. A represents all jumpers. B represents all runners. C represents all represents all swimmers. X can jump and swim, but cannot run. Find X.

6. John is a republican and/or a democrat. Where is John?

7. Bill is a philanthropist and an industrialist or an aristocrat and a philanthropist. Where is Bill?

8. A is found in group B or group C. B and C intersect. Where is A?

9. Draw a Venn diagram to illustrate: Point A is found $B \cap C \sim D$.
All three circles intersect.

10. Draw a Venn diagram to illustrate: Point A is found $X \cup Y \cap Z$.

Chapter 3

The Rules and Methods of Logic

Now that you are able to work syllogisms and illustrate problems with a form of symbolism, namely Venn diagrams, you are ready for the fascinating rules and methods of logical thinking itself.

PROPOSITIONS: Propositions are the basic and most important element of logic. A proposition is an ordinary statement involving terms which have been defined. They may state simple facts, such as:

The rain is coming down, here and now.

We really mean to say:

It is true that the rain is coming down, here and now.

If we mean to contradict this, we say:

It is false that the rain is coming down, here and now.

Logical reasoning is really the process of combining given propositions into other propositions, and then doing this over and over gain.

There are many ways of combining propositions, all of which are stemmed from three fundamental operations:

(1) Conjunction: Here we assert the simultaneous truth of two separate propositions.
Ex. - Jones is a farmer, and Smith is a plumber.

(2) Disjunction: In this case, we assert the truth of either or both of two separate propositions.
Ex. - I will go to the movies tonight, or I will go to the dance tomorrow. Here we must understand that the word "or" means not "one or the other", but instead, "either or both." In propositions, "or" means the same as "and/or."

(3) Implication: This usually takes the form of an "if then" sentence.
Ex. - If it snows tonight, then there will be no school tomorrow.

When we combine propositions, we usually stick to related propositions. As you can probably see by now, our syllogisms of chapter one were made up of propositions. Syllogisms use the third combining step - implication. Now let us see how propositions are combined in other ways, and how logical answers to problems are arrived at.

RULE OF ANALOGY: Analogy, in logic, implies the resemblance of relations. For example, to call a country that has set up various colonies the "mother country", implies an analogy between the relation in which it stands with its colonies to that which a mother holds to her children. Analogical reasoning may be reduced to the following formula: Two things resemble each other in one or more respects; a certain proposition is true of the one, therefore it is true of the other.

Another example of analogy is held between a brain and an electronic thinking machine, also called a "brain." If something is true of one, it must be true of the other. Say, for example, a brain can compute. We know right away that an electronic "brain" can compute also. That is the main resemblance between the two. In the analogical method, we combine by implication. If something is true of one, then it is true of the other.

RULE OF FALLACY: Fallacy, in logic, is an unsound mode of arguing which appears to carry truth and conviction and to be decisive of the question in hand, when in reality it is not. Fallacy will take the form of an argument or proposition, apparently true, though really fallacious, or untrue. Fallacies are calculated to deceive and mislead.

A fallacy may exist in the substance or in the form of the argument. However, unless it exists in the form it really does not deal with logic. Since it is hard to distinguish form from substance, we shall not dwell on this any longer here. We have included this merely to show the variations of logic.

RULE OF INFERENCE: Inference is the mental process of getting a new judgment from certain ideas. It is a proven fact that the brain passes from given facts to more or less assured conclusions. One example or this is: The clouds change from clear to dark. The more or less assured conclusion is that there will be a storm. This is not always an accurate method, but it serves a very good purpose. Another example of inference is: The family is putting tents and sleeping bags into the car. The more or less assured conclusion is that the family is going camping. The method of inference is the most widely used method of logic.

RULE OF NEGATION: The rule of negation simply deals with saying what is false. If a proposition states:

It is cold.

The negation would be:

It is false that it is cold.

Or:

It is not cold.

This can become very complicated, however. Take the proposition:

The sky is blue and the grass is green.

The negation would be:

It is false that the sky is blue, and the grass is green.

How would the proposition read in everyday English?

(1) The sky is not blue, and the grass is not green.
(2) The sky is blue, and the grass is not green.
(3) The sky is not blue, and the grass is green.
(4) The sky is not blue, or the grass is not green.

If we remember that "or" means "either or both", then we should be able to tell that the fourth proposition is true. The others might be true, but we don't know which is and which isn't. Obviously one of the others must be true, but we have no way of knowing which.

OTHER RULES OF LOGIC: The rules and methods of logic presented in this chapter make up only a small part of the complete set. If you are sufficiently interested in the study of logic, why not do some research on your own? Find out what the Rule of Contradiction is, and how Truth Tables work. Learn other methods of symbolic logic, and learn how the major and minor premises of a syllogism can be broken down into major and minor terms. Listed in the back of this unit are the references where we found the material to write this text. Try to get hold of some of them, and learn more about logic, the root of mathematics.

QUESTIONS:

1. What are the three basic methods of combining propositions?

2. Explain the meaning of "the cat is to the mouse, as the hunter is to the deer." Use the rule of analogy.

3. Write an analogical comparison between two objects.

4. Draw an inference from; "The man puts on his aqua-lung."

5. Draw an inference from; "The dog sees the cat."

6. What is the negation of:

   The sun is hot, and I don't care.

   When the negation is translated into everyday English, does it say:

   (1) The sun is not hot, and I care.
   (2) The sun is hot, and I care.
   (3) The sun is not hot, and I don't care.
   (4) The sun is not hot or I care.

7. Write an evaluation explaining what you think logic may mean to you in the future.

Chapter 4

Puzzle Problems

In this chapter we will discuss puzzle problems. Puzzle problems are interesting thought provoking and sometimes rather difficult. In some problems in this unit you will be given a method, however, in others you will have to follow your own native common sense.

In the nature of logical puzzles it is inherent that their solution cannot be reduced to a fixed pattern. Nevertheless, at this point it may be of help to offer certain suggestions for use in the following types of problems. An example is:

Boronoff, Pavlov, Revitsky, and Sukarek are four talented creative artists, one a dancer, one a singer, one a painter, and one a writer (though not necessarily in this order.)

1. Boronoff and Revitsky were present the night the singer made his debut in stage.
2. Both Pavlov and the writer have sat for their portraits by the painter.
3. The writer whose biography of Sukarek was a best seller is planning to write a biography of Boronoff.
4. Boronoff has never heard of Revitsky.

Obviously it is impossible to keep track of all the facts mentally. In order to do so we draw a chart breaking the problem down into a systematic study. We shall call this chart a truth table. A TRUTH TABLE for this problem would look like this.

	Dancer	Singer	Painter	Writer
Boronoff				
Pavlov				
Revitsky				
Sukarek				

According to the different propositions of the problem fill in the blanks with X's indicating the man is not that which the column indicates, and with O's to signify that is what the man is.

In the problem it was stated that (1) neither Boronoff nor Revitsky is the singer. From (2) we see that Pavlov is neither the painter nor the writer and from (3) we see that the writer is neither Boronoff nor Sukarek. If you had been filling in your truth table with the **X**'s it should have, it would look like this:

	Dancer	Singer	Painter	Writer
Boronoff		X		X
Pavlov			X	X
Revitsky		X	X	
Sukarek				X

According to (2) Revitsky had sat for the painter while according to (4) Boronoff does not know Revitsky. Therefore Boronoff isn't the painter, he is the dancer. By the same token it becomes apparent that Revitsky, Sukarek, and Pavlov aren't dancers. This makes Pavlov the singer and Revitsky the writer, thus leaving Sukarek to be the painter. The finished truth table would have looked like this.

	Dancer	Singer	Painter	Writer
Boronoff	O	X	X	X
Pavlov	X	O	X	X
Revitsky	X	X	X	O
Sukarek	X	X	O	X

Do the following problems using truth tables:

1. In a certain bank the positions of cashier, manager, and teller are held by Brown, Jones, and Smith (though not necessarily in that order.)

1. The teller, who was an only child, earns the least.
2. Smith, who married Brown's sister earns more than the manager.

What are the positions of the three men?

2. The Smith Family which consists of Mr. and Mrs. Smith, their son, Mr. Smith's sister, and Mrs. Smith's father has for years dominated the community life of Plainsville. At the present time the five members of the family hold among themselves the positions of the grocer, preacher, lawyer, postmaster, and teacher in the little town.

1. The lawyer and the teacher aren't blood relatives.
2. The grocer is younger than her sister-in-law but older than the teacher who won his letter playing college football who is older than the postmaster.

What are the positions of the people of the household?

In the Stillwater High School the economics, English, French, history, Latin and mathematics classes are, though not necessarily respectively, by Mrs. Arthur, Miss Bascomb, Mrs. Conroy, Mr. Duval, and Mr. Furness.

1. The mathematics teacher and the Latin teacher were college roommates.
2. Egglestion is older than Furness but has not taught as long as the economics teacher.
3. As students Mrs. Arthur and Miss Bascomb attended one high school while the others attended a different high school.
4. Furness is the French teacher's father.
5. The English teacher is the oldest of the six both in age and years of service. In fact he had the mathematics teacher and the history teacher in class when they were students at Stillwater High School.
6. Mrs. Arthur is older than the Latin teacher.

What subject does each person teach?

Now we shall try some problems that rely upon your own native common sense for the answer.

1. In a faraway land there dwelt two races. The Ananias who were terrible liars, while the other race, the Diogenes, were unfailingly truthful. Once a stranger visited the land, and on meeting three strangers inquired to what race each belonged. The first murmured some unintelligible phrase. The second remarked, "He said he was an Anania." The third said to the second, "You're a liar." The question is of what race is the third man.

2. "What else can I sell you today?", asked Elmer Johnson, the proprietor of Centerville's General Store.

"Well," replied Si Corning, "You'd better give me a couple of gallons of gas. My thrashing machine is a mite low."

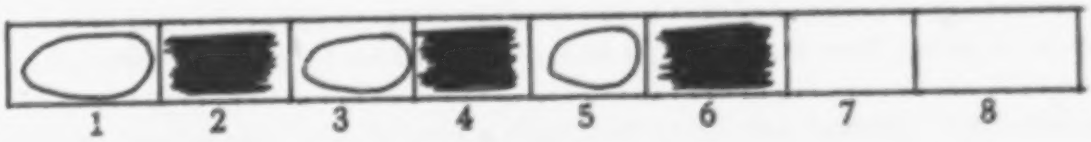
"Take five gallons while you can get it Si. Price is going up they tell me."

"No, I ain't going to lug five gallons all the way home. Make it two gallons."

"Fact is, Si, I don't have a two gallon measure. I got an eight gallong measure and plenty of five gallon cans lying around, but no two gallon cans. I don't see how I could give you an even two gallons."

Si thought for a moment or two then told Elmer what to do. Si got his two gallons, but the question is how.

3. The illustration shows the sheep (light) and the goats (dark) distributed alternatingly in a line of pens.



Now we wish to sort out the sheep from the goats, placing the sheet in the pens numbered 1, 2, and 3 and the goats in 4, 5, and 6. But these are gregarious animals who balk at being moved singly. To move at all we have to shift a pair of them to the empty pens. We cannot reverse the order of the pair in transit. For example, we can move 5 into 7 and 6 into 8, we cannot put 5 into 8 while 6 goes into 7.

After you have found how to sort the sheep from the goats try to do it in as few moves as possible. It can be done in four moves.

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PROJECT TITLE Science for Retarded Students
Alfred Coolidge, Donald Carson, Dr. Hal Brasell

Introduction

School experience of retarded students in a special education program should build and develop those capacities which are conducive to successful adjustment to the demands of present and adult living. However,, many school systems have experienced difficulty in developing an adequate curriculum for retarded students on the secondary level. The seriousness of this predicament is reflected by Harold M. Williams, Specialist for Education of Exceptional Children and Youth of the Department of Health, Education, and Welfare, Washington, D.C. In a letter to the writer in February, 1961, Williams stated: "...with regard to the curriculum for the older mentally retarded, we are still in something of a quandary, and are planning to start a special survey of this area within the next year."

One of the prime factors influencing curriculum development for retarded students has been the pressure of time. Retarded students, whether exogenous or endogenous types of mentally retarded, socially impoverished, emotionally disturbed, or other types, have proved incapable of keeping up with the pace of the 'regular' class. With the end objectives of social competence and economic efficiency in mind, educators have established 'practicality' as the screen for determining which subject areas should be included in the curriculum and which should be omitted.

This practice of continually monitoring curricular structure in light of desired behavioral goals is very commendable; however, a number of educators are wondering why the screen has not selected the area of science.

The hesitancy to include science in a practical curriculum must be challenged! Life adjustment education in this technological era must include science. It is essential that the retarded student be cognizant of at least part of the practical implications of science in order to continue to live with some degree of effectiveness, in order to adapt more successfully to the impartial laws of the world of nature, in order to fit in the mechanical-electronic world. For example, a person must be aware of the fact that more caution is necessary as one is driving on a wet highway when the temperature falls below freezing. It is of vital importance to know the source of carbon-monoxide gas and its danger when released in an enclosed area.

STATEMENT OF THE PROBLEM

In view of the possibilities science offers to successful life adjustment, the crucial question is this: CAN RETARDED STUDENTS ASSIMILATE INSTRUCTION REGARDING THE PRACTICAL IMPLICATION OF SELECTED AREAS OF SCIENCE?

In view of divergent opinion, it was the purpose of this pilot study to explore the possibilities of science in the curriculum of retarded students on the secondary level of Jefferson County's special education program.

This investigation was considered as a basic action research project. In view of this it should be understood that the class composition in this research included students retarded as a result of various factors, exogenous and endogenous mental retardation, emotionally disturbance, orthopedic conditions, partial vision, etc.

The road to the retarded students successful learning experience in the area of science is beset with many obstacles. For example: (1) The retarded student cannot read well enough to grasp the meaning of material discussing science; or if he can read the material, it is presented in a simple, childish way that is not geared to his more mature level of interest demands. (2) The retarded student has great difficulty in calculating and appreciating quantitative measurement used to present the significance of various scientific phenomenon. (3) The retarded student has difficulty in grasping the abstractions of scientific theory.

The following null-hypotheses were considered in the study:

I. Retarded students exposed to a curriculum including science which has a carefully structured series of learning experiences will learn no more about science than retarded students in whose curriculum science may occasionally appear according to the current interest of the teacher.

II. Retarded students who have teachers with access to an abundance and variety of teaching aids learn no more about science than retarded students whose teachers have access to the limited amounts and variety of teaching aids available under the usual classroom budget.

III. Due to the level of abstraction of scientific theory, retarded students cannot be taught scientific principles.

IV. There are no individual differences in retarded students' ability to grasp scientific principles.

V. Limitation in ability to appreciate quantitative variation precludes retarded students from gaining an understanding of the significance of scientific principles.

VI. Limited reading ability makes it impossible for the retarded student to derive meaning from a science course.

RESEARCH PROCEDURE

A. Grouping

The students enrolled in Jefferson County's classes for retarded students at the secondary level were divided into experimental and control groups. Each class was given a number followed by the letters 'E' or 'C', indicating experimental or control grouping. There were three classes in each junior high group. There were two high school classes in the experimental group and one class in the control group. The junior high experimental group had 31 students; the junior high school control group had 34 students. In the senior high groups there were 19 students in the experimental group and 13 students in the control group.

Individual class composition was reviewed. Composites of individual class data were made to compare junior and senior high school experimental and control groupings. The entire experimental group was compared with the entire control group.

In order to insure consistent comparison intelligence quotients were tabulated only when they were derived from employment of the Wechsler Intelligence Scale for Children or the Wechsler Adult Intelligence Scale.

In order to give some comparison in regard to the functioning of two channels of acquisition of knowledge in the classroom the Listen Comprehension part of the Durrell Reading Analysis and the Reading Comprehension part of the California Achievement Test were employed.

Information regarding the pre-test scores may be found in part III Data under these headings:

1. Pre-test Raw Scores on Form A of the Mechanical Reasoning Section of the Differential Aptitude Test (Table 3.)

2. Pre-test Scores on the Teacher Made Test on Machines (Table 5).

3. Pre-test Scores on the Teacher Made Test on Insulation (Tables 7 and 8).

The following is a description of class composition and class groupings used in this project:

CLASS COMPOSITION
Table 1

Experimental classes	No. in class	Handicap (primary)*		Chronological age		Intelligence Quotient (WISC, WAIS)			Listening comprehension (Durrell)**			Reading comprehension*** (California)		
		No.	Code	Mean	Range	No.	Mean	Range	No.	Mean	Range	No.	Mean	Range
1E	15	14 1	01 08	14-10	13-3 to 16-2	12	66	46-76	13	3.9	0-6+	10	2.7	1.5 to 4.3
2E	5	4 1	01 04	15-0	14-3 to 16-0	4	76	66-86	4	4.3	4-5	5	4.9	4.0 to 5.9
3E	11	5 1 3 2	01 06 07 ****	14-7	13-9 to 15-5	11	77	53-92	10	5.3	3-6+	9	5.2	3.8 to 7.0
4E	9	6 1 2	01 06 07	17-5	16-7 to 18-8	6	72	63-101	8	2.6	1-3	9	4.1	2.7 to 6.3
5E	10	7 3	01 07	17-1	14-3 to 18-0	7	81	77-90	9	3.3	2-5	8	4.6	3.2 to 5.8
Control classes														
1C	10	8 1 1	01 07 08	14-3	13-4 to 16-3	7	65	54-79	9	3.3	3-5	6	5.0	4.2 to 5.7
2C	11	9 1 1	01 06 07	15-4	14-7 to 16-4	9	72	58-91	9	4.1	2-6	11	3.9	1.9 to 6.6
3C	13	9 1 3	01 06 07	15-8	14-6 to 17-5	12	69	53-86	9	2.9	0-5	8	2.9	1.9 to 3.8
4C	13	10 1 1 1	01 07 08 ****	17-11	15-8 to 18-9	11	75	55-87	13	3.5	0-6+	10	5.6	3.0 to 7.5

* Jefferson County code for indicating types of handicapping conditions. 01, mentally retarded; 04, partially sighted; 06, orthopedic; 07, emotionally disturbed; 08, brain damaged, **** not classified.

** Durrell Analysis of Reading Difficulty, World Book Co., 1955

***California Achievement Tests, WXYZ Series, California Test Bureau, 1957.

**** Not classified.

CLASS GROUP COMPOSITION
Table 2

Experimental junior high	No. in class	Handicap (primary)		Chronological age		Intelligence quotient (WAIS, WISC)			Listening comprehension (Durrell)			Reading comprehension (California)		
		No.	Code	Mean	Range	No.	Mean	Range	No.	Mean	Range	No.	Mean	Range
1E, 2E, 3E Experimental jr. high	31	23 1 1 3 1 2	01 04 06 07 08 ****	14-8	13-3 to 16-2	27	74	46-92	28	4.4	0 to 6+	24	4.1	1.5 to 7.0
Experimental high school 4E & 5E	19	13 1 5	01 06 07	17-3	14-3 to 18-8	13	77	53-101	17	2.9	1-5	17	4.3	2.7 to 6.3
Experimental jr. & sr. 1E, 2E, 3E, 4E, 5E	50	34 1 2 8 1 2	01 04 06 07 08 ****	15-9	13-3 to 18-8	40	75	46-101	45	3.9	0 to 6+	41	4.2	1.5 to 7.0
Control jr. high 1C, 2C, 3C	34	26 2 5 1	01 06 07 08	15-1	13-4 to 17-5	28	69	53-91	27	3.5	0.6	25	3.8	1.9 to 6.6
Control high school 4C	13	10 1 1 1	01 07 08 ****	17-11	15-8 to 18-9	11	75	55-87	13	3.5	0.6	10	5.6	3.0 to 7.5
Control jr. & sr. High 1C, 2C, 3C, 4C	47	36 2 6 2 1	01 06 07 08 ****	15-11	13-4 to 18-9	39	71	53-91	40	3.5	0.6	35	4.4	1.9 to 7.5

B. Scheduling

Two science units were presented in the experimental groups; a ten week unit on machines and a four week unit on insulation. For the machine unit the subject of science was scheduled for 70 minutes per day in junior high class 3E, 50 minutes every other day in junior high classes 1E and 2E, and 100 minutes per day in senior high classes 4E and 5E. For the unit on insulation science was scheduled for 30 minutes per day in junior high classes 1E and 2E, 70 minutes per day in junior high class 3E, and 75 minutes per day in senior high classes 4E and 5E. During both units approximately one half of the scheduled science time was devoted to laboratory experience and one half to programmed learning experience.

C. Pre-tests

Each unit began with a pre-test concerning the material to be covered. The pre-test was given to both the experimental and the control groups. In view of the general lack of articulated sequences of learning experience in science, the pre-test was to some extent an inventory of the fragments of knowledge the students had absorbed during their life experience. Pre-test results served as an indicator for the beginning level of instruction. The primary purpose of pre-tests, however, was to establish a point from which to measure each student's progress or lack of progress.

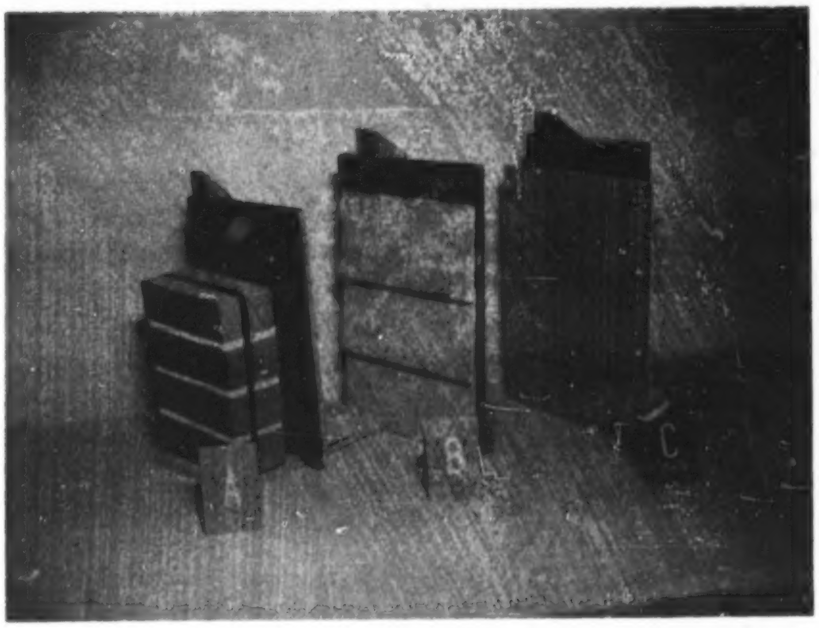
The pre-tests were read to the students as they followed the printed page.

The pre-tests were composed of multiple-choice questions. The questions were grouped within the pre-test by areas of subject matter covered in the class presentation.

The pre-test for machines presented sketches, which were the basis for each test item. The pre-test on insulation employed mock-ups of parts of a house, transparencies, sketches, and conventional non-illustrated items.

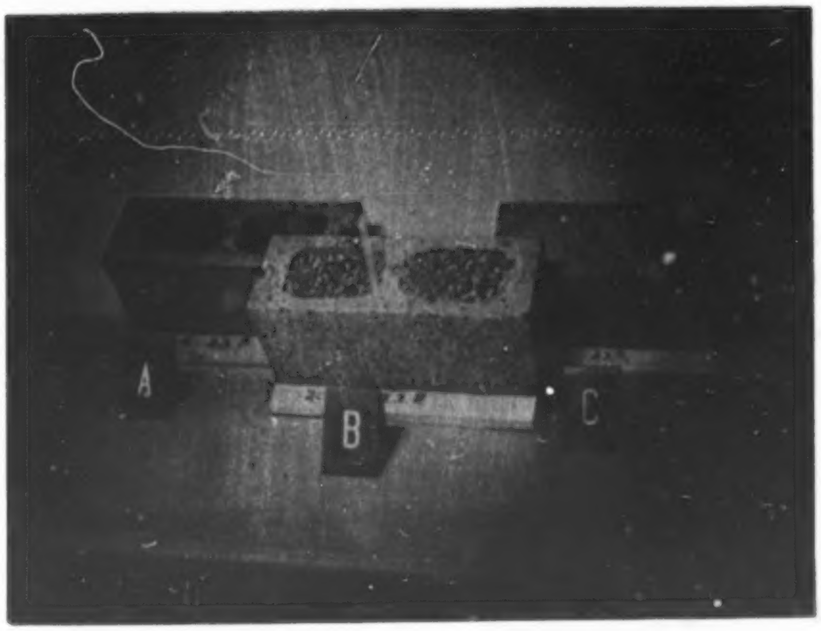
The following is a sample page of the machine pre-test and pictures of mock-ups used in the insulation unit, plates 1, 2, and 3.

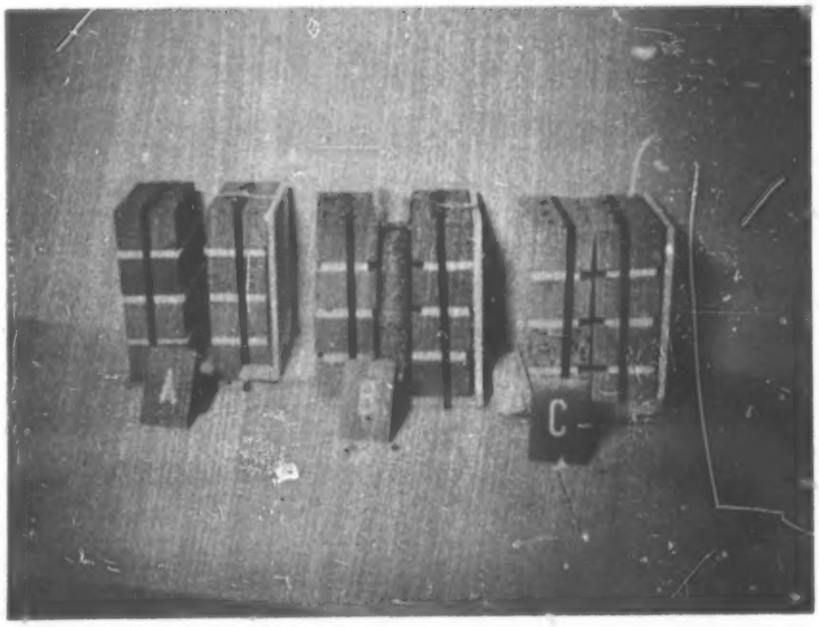
SAME PRE-TEST ITEMS FOR INSULATION UNIT



28. Which wall will keep the house warmest on the inside during the winter?

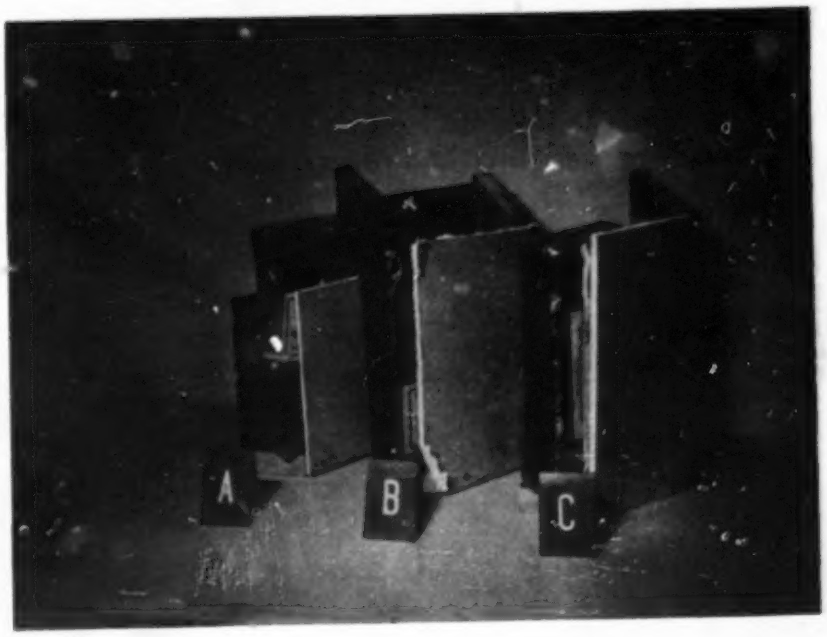
20. Which will let the most heat out of the house in winter?





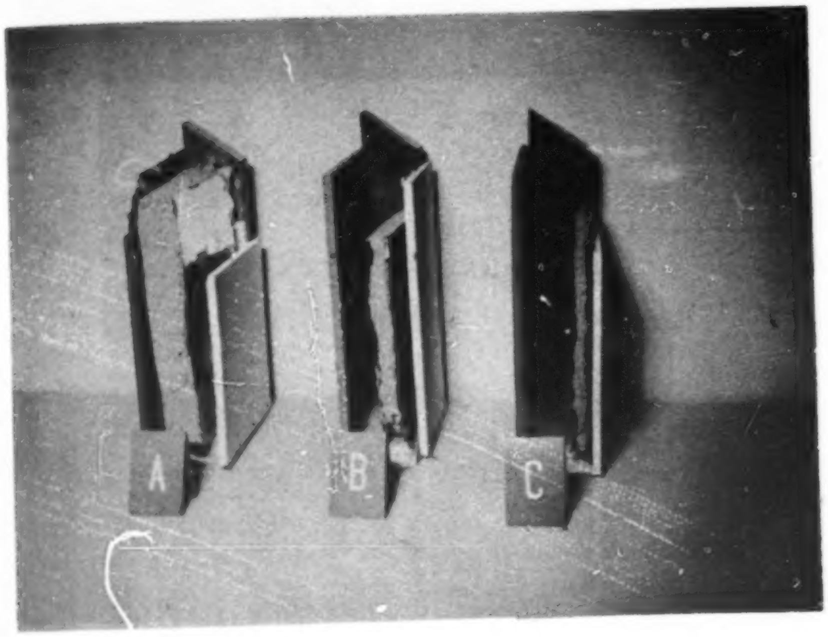
22. Which will keep the most heat inside the house in winter?

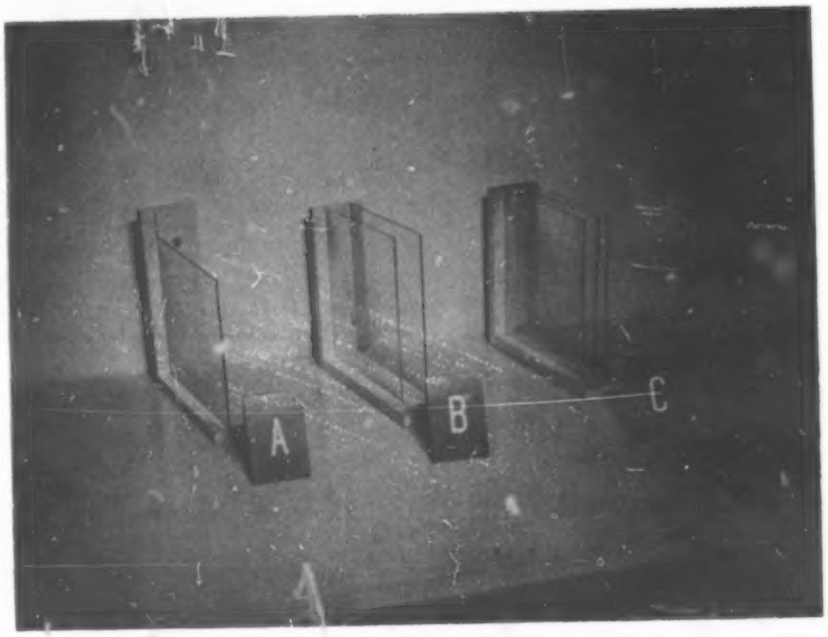
Plate 1



8. Which of these walls will keep the most heat inside a house in winter?

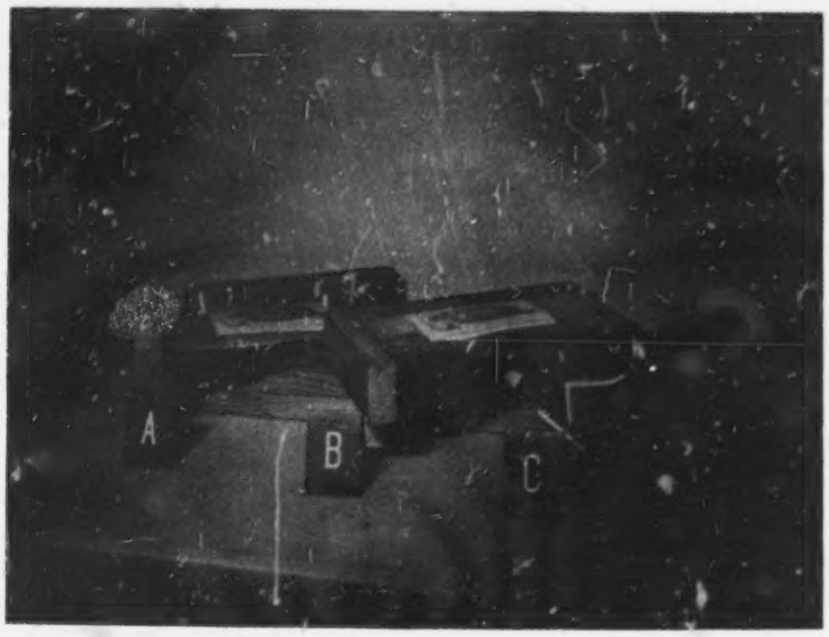
50. Which wall keeps the most heat out of a house in summer?





10. Which window would keep the most heat in a house in winter?

Plate 2



44. Which ceiling lets the most heat into a house in summer?

25. Which floor will keep the warmest in winter?

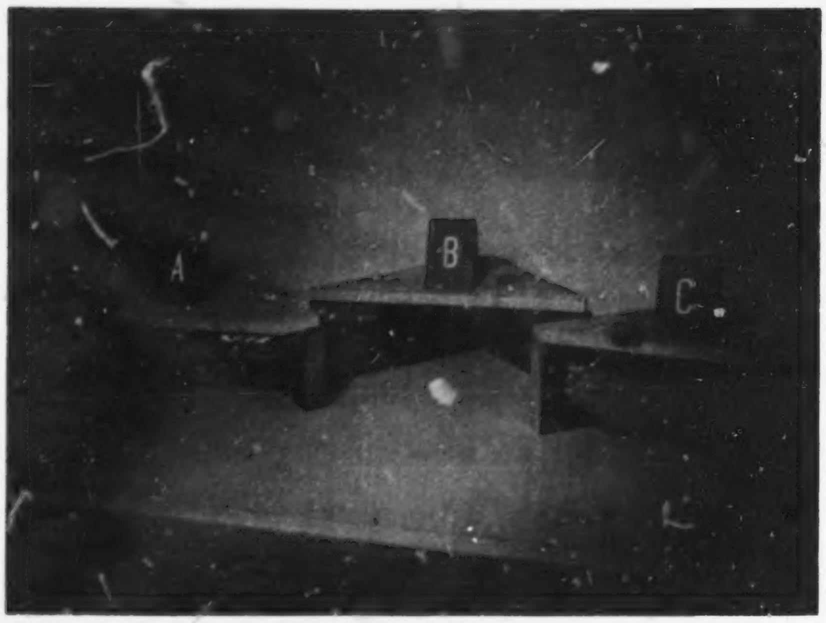
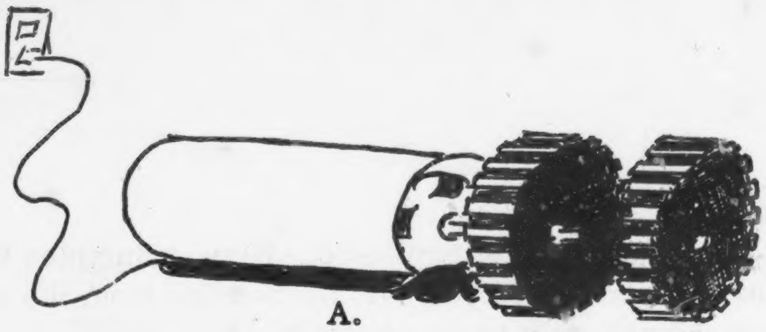
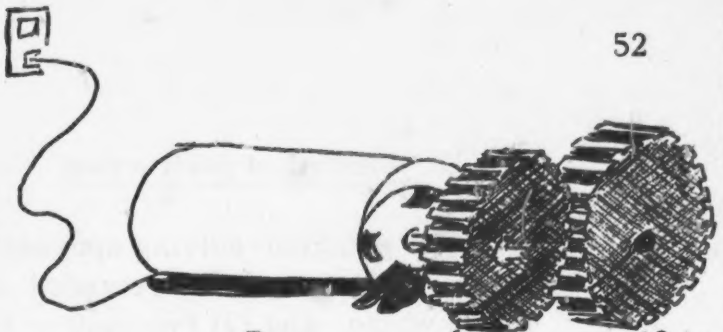
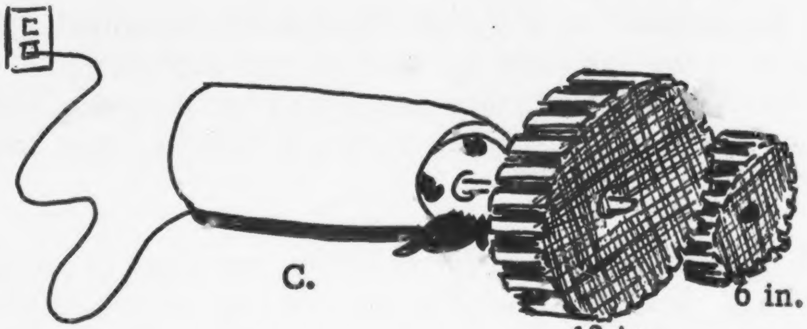


Plate 3

23.



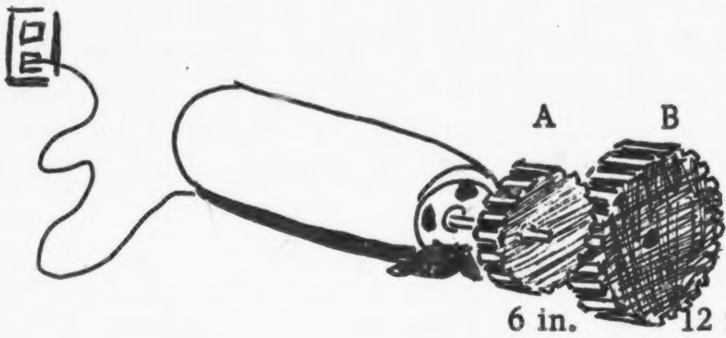




Which gears help the motor pull a heavier load?

A B C Same

24.

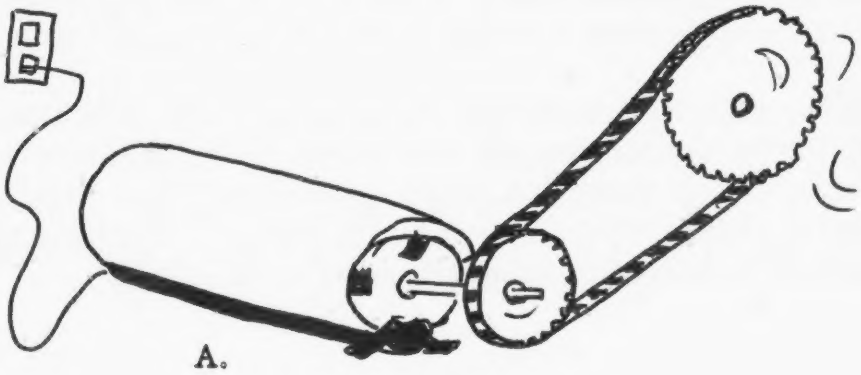


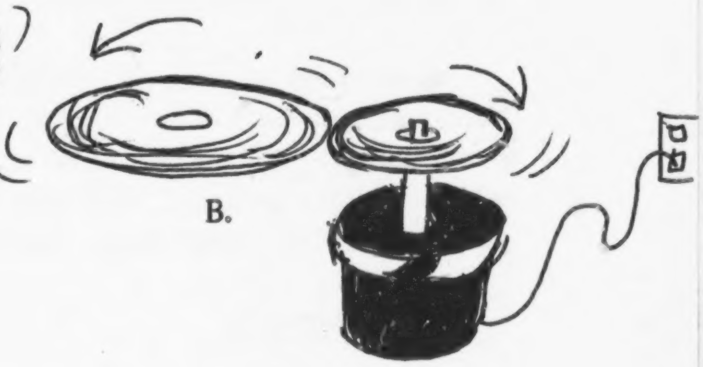
How do these gears help the motor do its work?

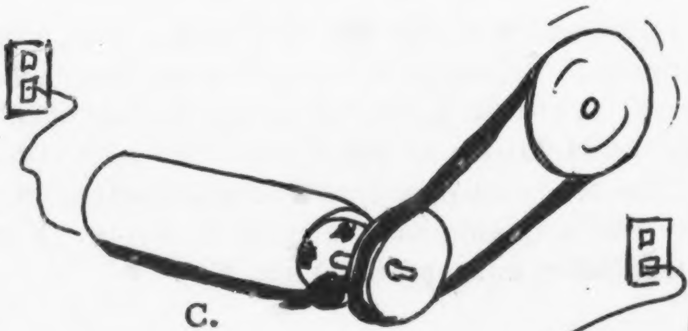
A. Makes gear B go faster.
B. Makes gear B turn slower but with more power.
C. Mechanical advantage of 4.
D. Large gear driven by smaller gear makes more power.
E. Large gear driven by smaller gear makes more speed.
F. Mechanical advantage of 2.

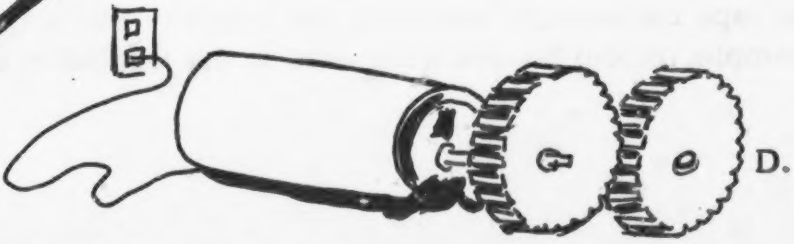
A B C D E F

25.









In which picture is the motor not being helped to pull a heavier load?

A B C D None

D. Method of Instruction

The problem-solving approach to instruction was employed. Basic principles for instruction of mentally retarded students were employed: (1) Proceeding from the part to the whole, and (2) Proceeding from the concrete to the abstract. Students were introduced to a phenomena demonstrated by the teacher. The students were given opportunity to theorize regarding the explanation of the phenomena demonstrated. The teacher, using positive contributions of the students, rounded out the explanation using concrete materials and/or audio-visual materials whenever possible. Students were then given opportunity to apply the principles in laboratory situations. Records were kept of their findings.

In the period following the laboratory experience every effort was made to circumvent the obstacle of limited reading ability. Students viewed movies or film strips on the subject when such teaching aids were available. Transparencies and sketches were used to illustrate basic concepts. Tape recordings were prepared to present information regarding the phenomenon being considered. Answers to questions asked on the tape gave teachers some indication of the student's grasp of the material. Selected portions of books and pamphlets were used when available on appropriate instructional or independent levels of difficulty. General discussion following the viewing tape and/or reading provided opportunity to work toward clarification of areas of misunderstanding or confusion. Students then worked together in a group situation to formulate the major principles involved in their own words. The chart story, so evolved, became the basis for student notebooks.

Teacher-made tests were administered during the units in order to gauge effectiveness of the learning situations that had been set up. Test items were manipulation of laboratory materials, multiple choice interpretation of sketches, or multiple choice questions. All questions and possible answers were presented in written form and also read orally.

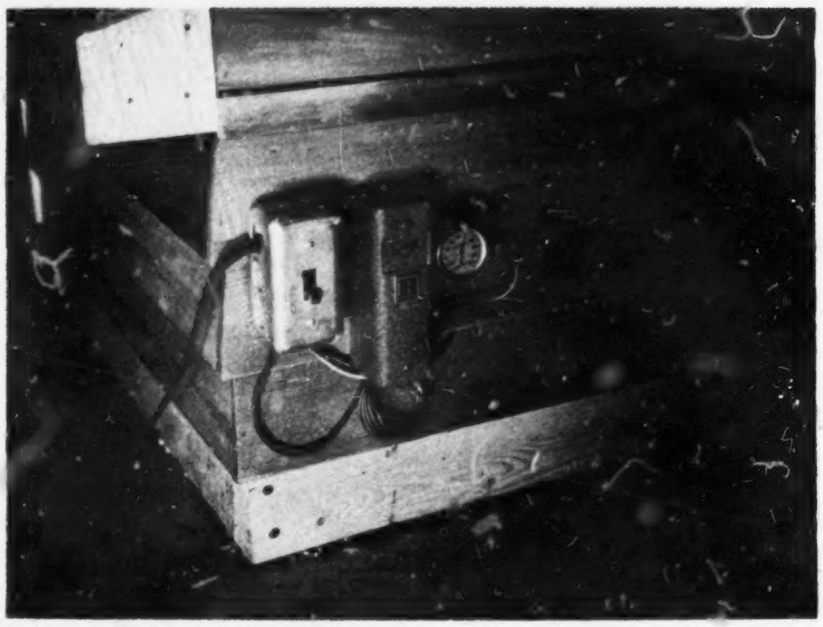
Continued repetition of the few select scientific principles of each unit was affected with some variation by relating the particular concept to different practical situations. For example: in the machine unit, gain in force was taught with levers, then with winches, then pulleys, then gears, chain-drive, 'V' belt drive, and direct drive. Variation guarded against monotony. Repetition served to reinforce previous learning.

E. Materials

In view of the fact that vivid sensory stimulation is important in the learning experience of retarded students, the multi-sensory approach pervaded the use of materials. Such audio-visual equipment as opaque projectors, overhead projectors and transparencies, slides, film strips, movies, tape recordings, and combinations of tape recordings with visual stimuli were called into play frequently. The teachers prepared transparencies, sketches and tape recordings; however, the primary teaching aids were concerete items. For example, model houses were used in the insulation unit, plates 4 and 5.

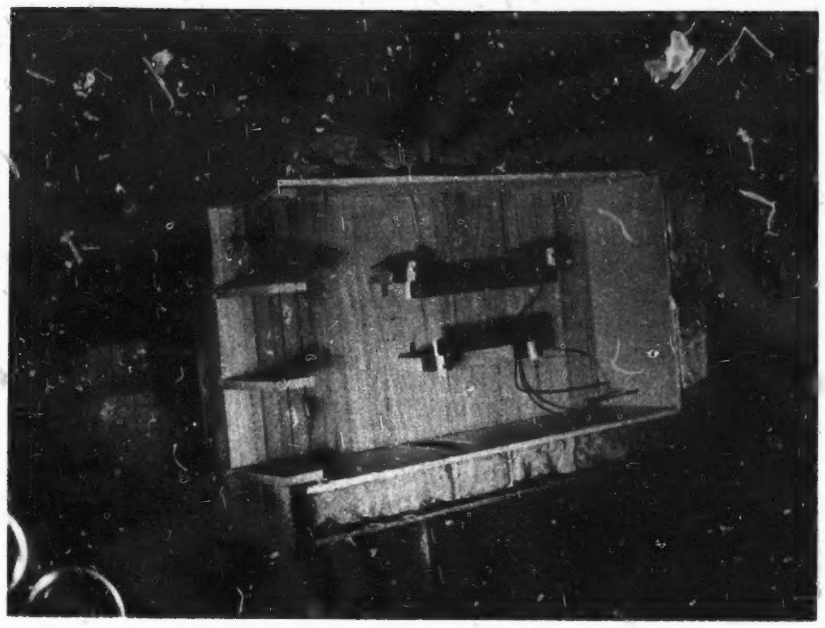
MODEL HOUSE

Exterior View
Asbestos siding
Double pane windows



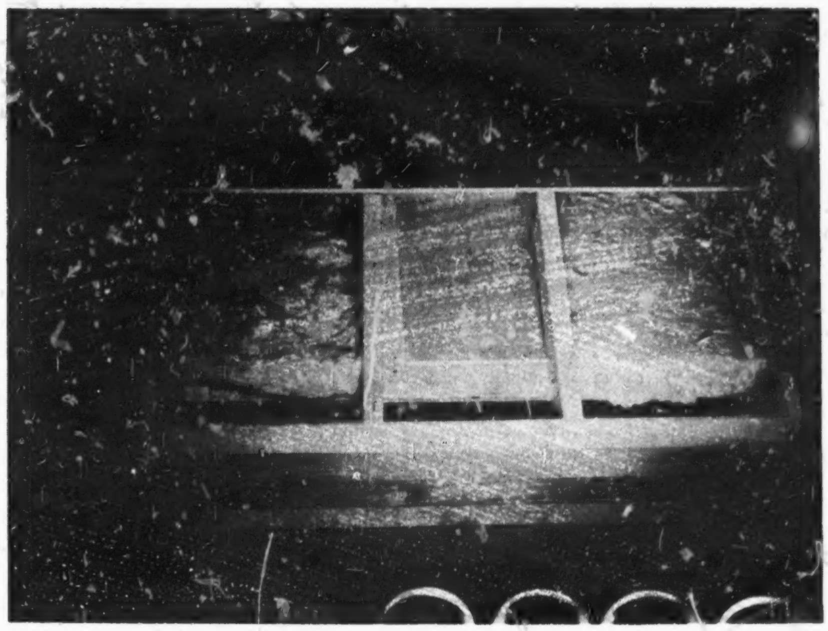
Exterior View
Lap siding
Control panel

Plate 4



Interior View
  Heating elements
  Interior wall insulation

Plate 5



Interior of attic
End section insulated
Middle section uninsulated

Interior of attic
End section uninsulated
Middle section insulated

Plate 6

Demonstrations by the teacher, student demonstrations, and some testing involved the use of concrete items. This enabled the students to get a better 'feel' of the subject matter being presented. In regard to concrete materials, opportunities for individual students to manipulate materials was considered preferable to group or teacher demonstration.

Post-test: The pre-test was administered at the close of each unit to assess the progress or lack of progress made by each student. Questions were made on various levels of difficulty in an endeavor to detect levels of concept mastery attained.

Evaluations pervaded the entire learning experience from pre-test through post-test. This included responses to teacher-made tests, printed and on tape; response to classroom discussion; observation of procedure and results in individual and group demonstrations; general observations by teachers regarding attitude, interest, participation in projects, discussion, concern and care evidenced in preparation of materials. The individual student's reaction to the units were solicited in a positive manner after the post-test was given and grades were recorded.

To illustrate the instructional approach described heretofore, sample materials for the unit on machines will follow. The sample material includes an introduction to the overall organization for presentation of the unit, and a portion of the instructional guide unit on machines.

MACHINES HELP US

DO WORK

This unit was designed to lead students to an understanding and appreciation of these selected principles: (1) How gain in force is affected through simple machines; (2) How gain in speed and/or distance is affected through simple machines; (3) How power may be transmitted from one place to another with no gain, gain in force, and gain in speed and/ or distance.

A study of the outline will reveal that a particular type of simple machine was studied first from the point of view of gain in force. After this had been thoroughly treated, the same machine was then studied from the point of view of gain in speed and/or distance. Only following the second presentation were the two considered together.

The science experience was divided into two general types: (1) laboratory experience; (2) programmed learning experience. The laboratory experience always preceded the programmed learning experience. The laboratory experience gave opportunity for first hand experience with the physical forces being studied. Students could see and feel the mechanical forces at work. The programmed learning period provided for assessment of knowledge, further clarification, and reinforcement of concepts learned in the laboratory experience. Generally, equal amounts of time were spent each day for laboratory and programmed learning; however, flexibility was allowed to meet the particular demand of the day.

[illegible]. A structure was designed to organize the learning experiences for each day in order to effectively present the concepts encountered in the part of the unit outline to be covered each day. The following is the organizational guide for daily classroom procedure for the entire unit.

STRUCTURE FOR ORGANIZATION OF DAILY LEARNING EXPERIENCES

LAB PROCEDURE
(presented first)

1. Introduce phenomenon with teacher-demonstration or student demonstration (Work from simple toward complex)
2. Students theorize as to reason for result demonstrated
3. Capitalize upon positive student contributions, teacher presents theory. (illustrated by transparency)
4. Manipulation of materials-- Individuals or work groups set up materials applying principles. Students keep record of findings where measurable.

* Where possible structure laboratory experience by going through steps 1-4 for simpler level before proceeding to more complex level. Go through steps 1-4 for successive levels of complexity.

** Teacher must supervise student demonstration to insure safety.

*** A great deal of advance preparation, including actual running of proposed student demonstrations must be done in order to insure successful student demonstrations.

PROGRAMMED LEARNING PROCEDURE
(presented after laboratory experience)

1. Tape, accompanied by transparencies, pictures illustrating principles dealt with in lab. Sketch items called for on tape
2. Check work sketched during tape presentation
3. Application of programmed information
   (a) Sketch machine described, indicating force, load, direction, force arm, load arm, etc.
   (b) Draw and/or name ways in which machine helps.
   (c) Draw a version of an efficient and an inefficient machine (load, force arm ratio)
   (d) Draw and/or name various manifestations of the machine encountered in daily experience.
   (e) Pose problem to be solved for mechanical advantage or gain in distance and/or 'speed'.

   (f) Using concrete materials provided for individuals, make a working model of the machine.

4. Check tests
5. Discuss and instruct to clear up points of confusion, use transparencies when available.
6. Group thinking to compose outline of important items to include in chart-story and notebooks: (a) Sketch of machine without indicating Force or Load arms; (b) List ways machine helps make work easier; (c) Sketch of machine; force and load arms highlighted in color - Blue, load; red, force. (d) Method of calculating mechanical advantage and/or gain in distance and/or 'speed'. (e) Cite relative distances that force and load travel. (For gain in force the force arm must move farther than the load arm; for gain in distance and/or 'speed' the load arm must move farther than the force arm)
7. Research: Find pictures in magazines, report on observation of machines of the type being considered, sketch illustration of machines observed or bring in actual machines.

Part of the programmed learning experience was tape teaching. The tape was geared to the outline of the unit. It was designed to compensate for two factors: (a) lack of printed material covering the subject in the special way it was organized; (b) the students' limited ability to grasp meaning from the printed word. The teacher preparing the tape gleaned segments of appropriate material from numerous sources, edited it, and elaborated on it. Following the presentation of a concept, the tape requested the students to answer questions regarding the material presented. The questions were the short answer type. Many times opportunity was provided to answer the question by a sketch, a word, or both. This gave the poor speller a better chance to get his idea across.

All classes were supplied with headsets and jackboxes. This was designed to facilitate grouping for instruction.

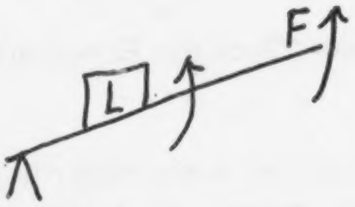
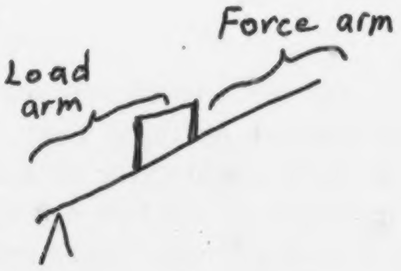
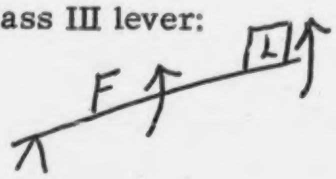
Throughout this unit there was an attempt to teach concepts on three different levels of difficulty. Wherever Group I appeared in the CONTENT column, the reference was the concept which was taught as the most superficial level of the principle involved. Where Group III appeared, the reference was to the most complicated concept level which was to be presented. The following is an example of the different concept levels:

B. Class II lever
    1. Lifting

Gr. I - Helps lift things
Gr. II - A short bite gives gain in force
Gr. III - $\frac{\text{Mechanical Advantage}}{\text{Load arm/ Force arm}}$

The following pages are samples taken from the guide for unit on machines.

CONTENT	LABORATORY ACTIVITY
B. Class II lever	
1. Gain in force a. Lifts 1) Principle - 2) Mechanical advantage a) Gr. I (helps lift) b) Gr. II (short load arm, long force arm helps c) Gr. III $\frac{\text{Mech. Adv.}}{\text{Load arm/ Force arm}}$ $\frac{\text{M.A.}}{\text{L/F}}$	Teacher demonstrates class II lever with saw horse and beam. Cite differences as force-load arm ratios are altered. Work group carries out study, recommending the most favorable arrangement to the rest of the class in a report. Student demonstrations: Using yard stick and spring scale lift a 1/4 pound weight, vary the force-load arm ratio. Teacher preplans settings on yard stick that work out to even M. A's.
b. Push 1) Principle 2) Mechanical advantage (similar to item 2 above)	Problem: How can a class II lever be set up to push things? Problem: How can a gain in force be affected in this situation?
c. Hold 1) Principle 2) Mechanical advantage (similar to item 2 above)	Problem: How can a class II lever be set up to hold a dolly which is part way up a ramp? Problem: How can gain in force be affected in this situation?
2. No gain in speed or distance a. Principle Load arm can never be longer than force arm	Demonstration: Set up a varied display of force-load-arm ratios. Measure the distance force and load travel.
3. Review	Students set up previous demonstrations as work groups and describe principle and outcome to rest of class.
4. Evaluation	Students set up demonstrations individually as assigned.
C. Class III lever	
1. No gain in force a. Principle Force arm can never be longer than load arm	Demonstrate: Set up display of varied force-load-arm ratios. Measure the distance load and force travel.
2. Gain in speed and/or distance a. Principle	Demonstration: Set up display above, focusing attention on gain in distance. Demonstration: Student shovelling Demonstration: Student sweeping with household broom; as contrasted to students sweeping with counter brushes
b. How it helps 1) Gr. I (moves things faster or farther) 2) Gr. II (load travels farther than force in the same amount of time)	Demonstration: Clear objects off a table top quickly by using yard stick as Class III lever

PROGRAMMED LEARNING ACTIVITY	MATERIAL CONCRETE	MATERIAL AUDIO-VISUAL	RESOURCE BOOKS
B. Class II lever Theme for Class II lever: 1) Principle: 	-saw horse 10' x 4" x 4" beam -yard sticks spring scales ring stands clamps to mount yard sticks in which attach		Science Instructional Guide. Jefferson County Public Schools 1961-62 pp. 8 En 8, 9 What is a Machine, p. 38.
2) Mechanical advantage Pictures of class II Gr. I levers that push, hold	to ring stand (clamp has a swivel) 1/4 pound weights	Industrial magazines	
Gr. II 	-dolly or wagon on ramp or hill solid stell crow bar 1 1/4" x 5'		
Small bite gives more force You trade distance and speed for force. Gr. III Same as Gr. II plus: $\frac{\text{M.A.}}{\text{L/F}}$			
Evaluation: Sketch answers to problem situations	-rulers for students to use at their desks		
C. Class III lever Theme for class III lever: Principle:  How it helps Gr. I, Pictures of sand levers that move things faster and farther Gr. II, (cont'd)	-yard sticks spring scales ring stands swivel clamps for yard sticks 1/4 pound weights -shovel -brooms (household) sweeping compound counter brushes		Science Instructional Guide, Jefferson County Public Schools, 1961-62 pp. 8 En 9, 10 What is a Machine, pp. 29-30

FORM OF EVALUATION

Two types of data were collected in this project, objective data and subjective data.

A. Objective Data on Multiple Choice Pre-Tests and Post-Tests for Experimental and Control Groups

The objective data involved responses to pre-tests and post-tests regarding the content of material covering the units on machines and insulation. All test items were multiple-choice; however the items the coices referred to ranged from actual objects through projected transparencies and sketches to abstraction of the printed word. Questions related to all test items were read orally to the students. There was no time limit. These tests were given to both experimental and control students. Only the scores of students completing both the pre-test and post-test were considered in the tabulation of data.

With the exception of one part of the test on machines, the tests were teacher made. The Mechanical Reasoning section of the standardized Differential Aptitude Test, produced by The Psychological Corporation in 1947, was used in conjunction with the teacher-made test on machines. Form A was used for the pre-test and Form B was used for the post-test. In using the standardized test, the prime concern was assessment of the depth of understanding and not the measurement of speed. Therefore, the instrument was administered according to instructions with the following exceptions: (1) Written portions of the test were read orally by the teacher; (2) All students were allowed to complete the test without regard to timing.

The teacher-made test serving as the pre-test also served as the post-test.

In the data which follows the pre-test scores and post-test gain are tabulated by classes and by junior high and senior high groups for both experimental and control groups.

1. The Unit on Machines.

a. Data on the Unit on Machines

TABLE 3

RAW PRE-TEST SCORES ON FORM A OF THE MECHANICAL REASONING SECTION OF THE DIFFERENTIAL APTITUDE TEST

EXPERIMENTAL				CONTROL			
Class	No. of Students	Total Score	Mean Score	Class	No. of Students	Total Score	Mean Score
1E	7	136	19.4	1C	9	186	20.7
2E	5	59	11.8	2C	11	160	14.5
3E	11	265	24.1	3C	8	115	14.4
Jr. high 1, 2, 3E	23	460	20.0	Jr. high 1, 2, 3C	28	461	16.5
4E	9	127	14.1	4C	7	121	17.3
5E	9	230	25.6				
Sr. high 4E, 5E	18	357	19.8	Sr. high 4C	7	121	17.3
Jr. and sr. high 1, 2, 3, 4, 5E	41	817	19.9	Jr. and sr. high 1, 2, 3, 4C	35	582	16.6

TABLE 4

GAIN IN UNDERSTANDING OF MECHANICAL PRINCIPLES AS INDICATED BY RAW SCORES FOR THE PRE-TEST AND POST-TEST ON DAT TEST OF MECHANICAL REASONING

EXPERIMENTAL					CONTROL				
Class	No. of Students	Total Gain	Mean Gain	Range of gain	Class	No. of Students	Total Gain	Mean Gain	Range of gain
1E	7	23	3.3	-6 to 10	1C	9	71	7.9	1 to 17
2E	5	57	11.	+1 to 18	2C	11	65	5.9	-6 to 19
3E	11	56	5.1	-6 to 17	3C	8	3	.4	-15 to 13
Jr. high 1, 2, 3E	23	136	5.9	-6 to 18	Jr. high 1, 2, 3C	28	139	5.0	-15 to 19
4E	8	126	15.8	-2 to 35	4C	7	71	11.3	1 to 31
5E	10	91	9.1	4 to 23					
Sr. High 4, 5E	18	217	12.1	-2 to 35	Sr. High 4C	7	71	11.3	1 to 31
Jr. High and Sr. High 1, 2, 3, 4, 5E	41	353	8.6	-6 to 35	Jr. High and Sr. High 1, 2, 3, 4C	35	218	6.2	-15 to 31

b. Teacher-made test. This test was composed of two types of questions: (1) single answer questions, 2) questions with three possible correct choices. The choices in the latter were rated according to the level of concept of the answer. (Lever I, one point, level II, 2 points, level III, 3 points)

TABLE 5
PRE-TEST SCORES ON THE TEACHER MADE TEST ON MACHINES

EXPERIMENTAL				CONTROL			
Class	No. of Students	Total Score	Mean Score	Class	No. of Students	Total Score	Mean Score
1E	5	43	8.6	1C	8	72	9.0
2E	4	26	6.5	2C	10	76	7.6
3E	11	101	9.2	3C	8	53	6.6
Jr. hi 1,2,3E	20	170	8.5	Jr. hi 1,2,3C	26	201	7.7
4E	9	74	8.2	4C	11	81	7.0
5E	9	73	8.1				
Sr. Hi 4,5E	18	147	8.2	Sr. hi 4C	11	81	7.0
Jr. & Sr. hi 1,2,3, 4,5E	38	317	8.3	Jr. & Sr. hi 1,2,3, 4C	37	282	7.6

Part II Concept Level Scores:

EXPERIMENTAL					CONTROL		
Class	No. of Students	Total Score	Mean Score	Class	No. of Students	Total Score	Mean Score
1E	5	71	14.5	1C	8	118	14.8
2E	4	50	12.5	2C	10	113	11.3
3E	11	157	14.3	3C	8	96	12.0
Jr. hi 1,2,3E	20	278	13.9	Jr. hi 1,2,3C	26	327	12.6
4E	9	109	13.9	4C	11	135	12.3
5E	9	132	14.7				
Sr. hi 4,5E	18	248	13.8	Sr. hi 4C	11	135	12.3
Jr. & Sr. hi 1,2,3, 4,5E	38	526	13.8	Jr. & Sr. hi 1,2,3 4C	37	462	12.5

TABLE 6

GAIN IN UNDERSTANDING OF OPERATION OF SIMPLE MACHINES, A PRE-POST-TEST COMPARISON, OF THE TEACHER MADE TEST

EXPERIMENTAL				CONTROL			
Class	No. of Students	Total Score	Mean Score	Class	No. of Students	Total Score	Mean Score
1E	11	19	1.8	1C	8	-4	-.5
2E	5	9	1.8	2C	10	6	.6
3E	4	7	1.8	3C	8	6	.8
Jr. hi 1, 2, 3E	20	35	1.8	Jr. hi 1, 2, 3C	26	8	.3
4E	9	18	2.0	4C	11	-7	-.6
5E	9	23	2.6				
Sr. hi 4, 5E	18	41	2.3	Sr. hi 4C	11	-7	-.6
Jr. & sr. hi 1, 2, 3, 4, 5E	38	76	2.0	Jr. & sr. hi 1, 2, 3, 4C	37	1	.03

Concept level scores:

	EXPERIMENTAL				CONTROL		
Class	No. of Students	Total Score	Mean Score	Class	No. of Students	Total Score	Mean Score
1E	11	16	1.5	1C	8	15	1.9
2E	5	-9	-1.8	2C	10	3	.3
3E	4	6	1.5	3C	8	-10	-1.3
Jr. hi 1, 2, 3E	20	13	.7	Jr. hi 1, 2, 3C	26	8	.3
4E	9	57	6.3	4C	11	24	2.2
5E	9	25	2.8				
Sr. hi 4, 5E	18	82	4.6	Sr. hi 4C	11	24	2.2
Jr. & sr. Hi 1, 2, 3, 4, 5E	38	95	2.5	Jr. & sr. hi 1, 2, 3, 4C	37	32	.9

b. Observations Regarding Objective Data on Unit on the Operation of Simple Machines

1. Pre-test inventory of operation of machines.

a.) Form A of the Mechanical Reasoning Section of the Differential Aptitude test. Table 3 indicates that the mean raw scores for the for the Mechanical Reasoning test were higher for the experimental group. The experimental junior high group (20.0) was higher than the control junior high group (16.5). The experimental senior high group (19.8) was higher than the control senior high group (17.3). The total experimental group (19.9) scored higher than the total control group (16.6).

The junior high experimental group (20.0) scored higher than the senior high experimental group (19.8). The junior high control group (16.6) did not score as high as the senior high control group (17.3).

b.) Teacher-Made Test on Machines.

Single answer questions. Table 5 shows higher mean scores for the experimental group. The experimental junior high group (8.5) was higher than the control junior high group (7.7). The senior high experimental group (8.2) was higher than the senior high control group (7.0). The entire experimental group (8.3) was higher than the entire control group (7.6).

The junior high experimental group (8.5) surpassed the high school experimental group (8.2). The junior high control group (7.7) also scored higher than the senior high control group (7.0).

Concept level questions. Table 5 presents a similar picture concept level questions. The experimental junior high group (13.9) rated higher than the control junior high group (12.6). The senior high experimental group (13.8) excelled the senior high control group (12.3). Thereby the total experimental group (13.8) was higher than the total control group (12.5).

The junior high groups surpassed their respective high school groups. The junior high experimental group (13.9) was higher than the senior high experimental group (13.8). The junior high control group (12.6) scored higher than the senior high control group (12.6).

2. Post-test gain following instruction on the operation of machines.

a.) Form B of the Mechanical Reasoning section of the Differential Aptitude Test. Results on the post-test on Mechanical Reasoning, Table 4, present a mean gain for the experimental groups which surpassed the control groups. The junior high experimental group (5.9) had a greater mean gain than did the junior high control group (5.0). The senior high experimental group (12.1) registered a higher mean gain than the senior high control group (11.3). The total experimental group (8.6) made a greater mean gain than the total control group (6.2).

A comparison of junior high and high school levels indicates that the high school groups made the greatest mean gain. The junior high experimental group (5.9) made less gain than the senior high experimental group (12.1). The junior high control group (5.0) made less gain than the senior high control group (11.3).

b.) Teacher made test on machines.
Single answer questions. Table 6 indicates greater mean gain by the experimental groups on the single answer questions. The junior high experimental group (1.8) had a greater mean gain than the junior high control group (.3). The senior high experimental group (2.3) registered a greater mean gain than the senior high control group (-.6). The entire experimental group (2.0) surpassed the entire control group (.03).

The high school experimental group (2.3) made greater mean gain than the junior high experimental group (1.8). The junior high group (.3) excelled the senior high group (-.6).

c.) Concept level questions. Table 6 reveals a greater mean gain for experimental groups on the concept level questions. The junior high experimental (.7) made greater gain than the junior high control group (.3). The senior high experimental group (4.6) made more gain than the senior high control group (2.2). The total experimental group (2.5) made greater gain than the total control group (.9).

The junior high level did not make as great a mean gain as did their respective senior high groups. The junior high experimental group (.7) made less gain than the senior high experimental group (4.6). The junior high control group (.3) made less gain than the senior high control group (2.2).

3. The Unit on Insulation

a.) Data on the unit on insulation.

TABLE 7.

PRE-TEST SCORES ON TEACHER-MADE TEST ON INSULATION, HOME INSULATION SECTION

1. Home insulation section (concrete test items)

EXPERIMENTAL					CONTROL				
Class	No. of Students	Total Score	Mean Score	Range	Class	No. of Students	Total Score	Mean Score	Range
1E	11	275	25.0	14-39	1C	8	197	24.6	17-35
2E	4	103	25.8	22-30	2C	10	245	24.5	17-34
3E	11	292	26.6	19-35	3C	8	144	18.0	8-36
Jr. hi 1, 2, 3E	26	670	25.8	14-35	Jr. hi 1, 2, 3C	26	586	22.5	8-36
4E	7	180	27.1	21-34	4C	12	290	24.1	13-36
5E	6	198	33.0	29-44					
Sr. hi 4, 5E	13	378	29.1	21-44	Sr. hi 4C	12	290	24.1	13-36
Jr. & sr. hi 1, 2, 3, 4, 5E	39	1048	26.9	14-44	Jr. & sr. hi 1, 2, 3, 4C	38	876	23.1	8-36

2. Home insulation section (transparencies, sketches, and multiple choice)

EXPERIMENTAL					CONTROL				
Class	No. of Students	Total Score	Mean Score	Range	Class	No. of Students	Total Score	Mean Score	Range
1E	7	133	19.0	9-27	1C	8	164	20.5	16-26
2E	4	75	18.8	15-24	2C	9	151	16.7	13-22
3E	11	236	21.4	15-27	3C	6	91	15.1	14-20
Jr. hi 1, 2, 3E	22	444	20.2	9-27	Jr. hi 1, 2, 3C	23	406	17.7	13-26
4E	8	144	18.0	12-29	4C	11	146	13.2	8-23
5E	7	147	21.0	16-26					
Sr. hi 4, 5E	15	291	19.4	12-29	Sr. hi 4C	11	146	13.2	8-23
Jr. & sr. high 1, 2, 3, 4 5E	37	735	19.6	9-29	Jr. & sr. high 1, 2, 3, 4C	34	552	16.2	8-26

TABLE 8

PRE-TEST SCORES ON TEACHER-MADE TEST ON INSULATION, FOOD AND CLOTHING SECTIONS

1. Insulation in Preparing and Keeping Food (multiple choice)

EXPERIMENTAL					CONTROL				
Class	No. of Students	Total Score	Mean Score	Range	Class	No. of Students	Total Score	Mean Score	Range
1E	14	116	8.3	0-13	1C	8	76	9.5	8-10
2E	4	38	9.5	8-12	2C	9	78	8.6	6-13
3E	11	96	8.7	6-11	3C	6	48	8.0	5-11
Jr. hi 1, 2, 3E	29	250	8.6	0-13	Jr. hi 1, 2, 3C	23	202	8.8	5-13
4E	8	76	9.5	5-13	4C	11	91	8.2	5-11
5E	7	72	10.1	9-13					
Sr. hi 4, 5E	15	148	9.9	5-13	Sr. hi 4C	11	91	8.2	5-11
Jr. & Sr. hi 1, 2, 3, 4, 5E	44	398	9.0	0-13	Jr. & sr. hi 4C	33	293	8.9	5-13

2. Insulation and Selection of Clothing (multiple choice)

Class	No. of Students	Total Score	Mean Score	Range	Class	No. of Students	Total Score	Mean Score	Range
1E	14	153	10.9	3-17	1C	8	93	11.6	7-14
2E	4	41	10.3	8-13	2C	11	110	10.0	4-14
3E	11	126	11.4	4-16	3C	7	68	9.7	7-12
Jr. hi 1, 2, 3E	29	320	11.0	3-17	Jr. hi 1, 2, 3C	26	271	10.4	4-14
4E	8	97	12.1	9-16	4C	11	123	11.1	9-15
5E	7	93	13.2	8-17					
Sr. hi 4, 5E	15	190	12.6	8-17	Sr. hi 4C	11	123	11.1	9-15
Jr. & sr. hi 1, 2, 3, 4 5E	44	510	11.6	3-17	Jr. & sr. hi 1, 2, 3, 4C	37	394	10.7	4-15

TABLE 9

COMPARATIVE GAIN IN UNDERSTANDING OF PRINCIPLES OF HOME INSULATION

1. Home insulation section (concrete materials as test items)

EXPERIMENTAL					CONTROL				
Class	No. of Students	Total Gain	Mean Gain	Range	Class	No. of Students	Total Gain	Mean Gain	Range
1E	11	25	2.3	-7 to 9	1C	8	9	1.1	-8 to 9
1B	4	19	4.8	1 to 8	2C	10	13	1.3	-1 to 6
1C	11	53	4.8	-9 to 17	3C	8	29	3.6	-3 to 12
Jr. hi 1, 2, 3E	26	97	3.7	-9 to 17	Jr. hi 1, 2, 3C	26	51	2.0	-8 to 12
4E	7	20	2.9	-5 to 14	4C	12	1	.1	-12 to 9
5E	6	-6	-1.0	-6 to 3					
Sr. hi 4, 5E	13	14	1.1	-6 to 14	Sr. hi 4C	12	1	.1	-12 to 9
Jr. & sr. hi 1, 2, 3, 4, 5E	39	111	2.9	-9 to 17	Jr. & sr. hi 1, 2, 3, 4C	38	52	1.4	-12 to 12

2. Home insulation section (transparencies, sketches, and multiple choice)

EXPERIMENTAL							CONTROL		
Class	No. of Students	Total Gain	Mean Gain	Range	Class	No. of Students	Total Gain	Mean Gain	Range
1E	6	2	.3	-2 to 2	1C	8	-14	-1.8	-6 to 4
2E	4	-7	-.5	-6 to 0	2C	9	12	1.3	-3 to 10
3E	11	45	4.1	-5 to 17	3C	6	-8	-1.3	-5 to 2
Jr. hi 1, 2, 3E	21	40	1.3	-6 to 17	Jr. hi 1, 2, 3C	23	-10	-.4	-6 to 10
4E	8	43	5.4	-6 to 13	4C	11	11	1.4	-7 to 13
5E	7	40	5.7	2 to 9					
Sr. hi 4, 5E	15	83	5.5	-6 to 13	Sr. hi 4C	11	15	1.4	-7 to 13
Jr. & sr. hi 1, 2, 3, 4, 5E	36	123	3.4	-6 to 17	Jr. & sr. hi 1, 2, 3, 4C	39	5	.1	-12 to 13

TABLE 10

COMPARATIVE GAIN IN UNDERSTANDING OF INSULATING PRINCIPLES RELATED TO CARE OF FOOD AND SELECTION OF CLOTHING

1. Insulation; Preparing and Caring for Food (multiple choice)

EXPERIMENTAL					CONTROL				
Class	No. of Students	Total Gain	Mean Gain	Range	Class	No. of Students	Total Gain	Mean Gain	Range
1E	14	7	.5	-4 to 5	1C	8	4.0	.5	-1 to 3
2E	4	-2	-.5	-4 to 4	2C	9	-3.0	-.3	-1 to 2
3C	11	12	1.1	-2 to 4	3C	6	-1.0	-.2	-1 to 3
Jr. hi 1, 2, 3E	18	17	.9	-4 to 5	Jr. hi 1, 2, 3C	23	0	0	-1 to 3
4E	8	13	1.6	-2 to 5	4C	11	16	1.5	-2 to 12
5E	7	-4	-.6	-4 to 1					
Sr. hi 4, 5E	15	9	.6	-4 to 5	Sr. hi 4C	11	16	1.5	-2 to 12
Jr. & sr. hi 1, 2, 3, 4 5E	33	26	.8	-4 to 5	Jr. & sr. hi 1, 2, 3, 4C	34	16	.5	-2 to 12

2. Insulation and the Selection of Clothing (multiple choice)

EXPERIMENTAL					CONTROL				
Class	No. of Students	Total Gain	Mean Gain	Range	Class	No. of Students	Total Gain	Mean Gain	Range
1E	14	44	3.1	-2 to 9	1C	8	16	2.0	-2 to 5
2E	4	13	3.3	1 to 4	2C	11	18	1.6	-3 to 6
3E	11	30	2.7	-2 to 10	3C	7	4	.6	-3 to 3
Jr. hi 1, 2, 3E	29	87	3.0	-2 to 10	Jr. hi 1, 2, 3C	26	38	1.5	-3 to 6
4E	8	16	2.0	-1 to 6	4C	11	-7	-.6	-5 to 2
5E	7	22	3.1	1 to 7					
Sr. hi 4, 5E	15	38	2.5	-1 to 7	Sr. hi 4C	11	-7	-.6	-5 to 2
Jr. & sr. hi 1, 2, 3, 4, 5E	44	125	2.9	-2 to 10	Jr. & sr. hi 1, 2, 3, 4C	37	31	.8	-5 to 6

b. Observations Regarding Data on the Unit on Insulation

1) Pre-test inventory on factors in insulation.

a) Home insulation (concrete objects, Table 7). The experimental junior high group (25.8) had a higher mean score than the control junior high (22.5) and the experimental senior high group (29.1) was higher than the control senior high (24.1). The total experimental group (29.4) thereby registered a higher mean score than the total control group (23.1). The experimental senior high group (26.9) scored higher than the experimental junior high group (25.8).

b) Home insulation (transparencies, sketches, and multiple choice, Table 7). The experimental group (19.6) had a higher mean score than the control group (16.2). The experimental junior high (20.2) was higher than the control junior (17.7); and the experimental senior high (19.4) exceeded the control senior high (13.2). The experimental junior high (20.2) attained a higher score than the experimental high school group (19.4).

c) Insulation in Preparing and Keeping Food (multiple choice, Table 8). Although the total experimental group (9.0) registered a higher mean score than the total control group (8.9), the control junior high group (8.8) made a higher score than the experimental junior high group (8.6). The experimental senior high group (9.9) was higher than the control senior high group (8.2). The experimental senior high group (9.9) made a higher mean score than the experimental junior high group (8.6).

d) Insulation and Selection of Clothing (multiple-choice), Table 8. The experimental group (11.6) attained a higher mean score than the control group (10.7). The experimental junior high group (11.0) had a higher mean score than the control junior high group (10.4). The experimental senior high (12.6) was higher than the control senior high (11.1). The experimental senior high group (12.6) was higher than the experimental junior high group (11.0).

2) Post-test gain following instruction regarding factors in insulation.

a) Home insulation (concrete objects, Table 9). The total experimental group (2.9) scored a greater mean gain than the total control group (1.4). The experimental junior high (3.7) made greater gain than the control junior high (2.0). The experimental senior high (1.1) made more gain than the control senior high (.1). The experimental junior high (3.7) surpassed the experimental senior high (1.1) in mean gain.

b) Home insulation (transparencies, sketches, and multiple-choice, Table 9) The total experimental group (3.4) exceeded the total control group (.1) in mean gain. The experimental junior high (1.9) and senior high (5.5) groups made greater gain than the control junior (-.4) and senior high (1.4) groups. The experimental senior high group (5.5) attained greater mean gain than the experimental junior high group (1.9).

c) Insulation in preparing and keeping food (multiple choice, Table 10). The mean gain for the total experimental group (.8) was greater than that of the total control group (.5); however the control senior high (1.5) surpassed the experimental senior high (.6). The experimental junior high (.9) made a greater mean gain than the control junior high (0). The experimental junior high (.9) made more gain than the experimental senior high (.6).

d) Insulation and the selection of clothing (multiple choice, Table 10) The entire experimental group (2.9) made greater mean gain than the entire control group (.8). The experimental junior high (3.0) exceeded the control junior high (1.5); and the experimental senior high (2.5) exceeded the control senior high (-.6). The experimental junior high (3.0) surpassed the experimental senior high (2.5).

B. Subjective Data on Participation of Experimental Groups in the Learning Experiences of the Units on Machines and Insulation.

The subjective data involves student reactions to the units and teacher observation of student participation in the learning experiences of the units.

The subjective reactions involve a battery of questions designed and administered to students to elicit their reaction to the unit under consideration. Questions were designed to draw out value judgments regarding interest, significance of unit content for application in daily living situations, the relevance of laboratory experiences and the use of concrete materials in developing a greater understanding of the principles of the particular unit, and the value of tape recordings as a learning tool.

The teacher observation forms were checklists designed to give an indication of each students interest, academic accomplishment, and level of participation in a laboratory situation.

1. The Unit on Machines.

a) Student reaction

1) Data on student reaction to the unit on machines for 18 junior high students and 17 senior high students.

TABLE 11

STUDENT REACTION REGARDING THE LEARNING EXPERIENCE OF EXPERIMENTAL STUDENTS IN THE UNIT ON MACHINES, A Percentage Treatment of Subjective Data

	Interest in the Unit	Significance of the unit for daily living	
	a. Did you like the unit on machines?	b. Will things you learned help you?	c. Do you think that what you learned will help you when you are out of school?
Junior			
No	31%	11%	16%
Don't Know	0	5%	31%
Yes	69%	83%	53%
Senior			
No	43%	35%	29%
Don't Know	5%	12%	6%
Yes	52%	53%	65%

	Laboratory Experience		
	d. Did working with real things in the lab help you understand machines better?	e. Did the test using real gears, scissors chisels, power tools and other things show you what you really learned and what you still needed to know?	f. Did the use of real things in class help you see how machines can help you in work you do each day?
Junior			
No	25%	21%	21%
Don't Know	12%	5%	0
Yes	53%	74%	79%
Senior			
No	23%	23%	23%
Don't Know	6%	18%	0
Yes	71%	59%	77%

	Tape Recordings	
	g. Did the tape recordings help?	h. Did the questions on the tape recordings help?
Junior		
No	47%	16%
Don't Know	26%	47%
Yes	26%	37%
Senior		
No	53%	41%
Don't Know	6%	12%
Yes	41%	47%

2. Observations regarding student reaction to the unit on machines (Table 11)

In response to question a, on interest, the junior high group (69%) indicated greater interest in the unit than the senior high group (52%).

In questions b and c on signficance for practical application, the junior high group was the least prone to indicate that their was no value for practical application (11% and 16% respectively); the high school group had a higher percentage who failed to see the practical value (35% and 29% respectively). In response to question b, 83% of the junior high group saw positive value and 53% of the senior high group saw positive value. In response to question c, 53% of the junior high group indicated positive practical value and 65% of the senior high group so indicated.

The laboratory experience and the use of concrete materials (questions d-f) were valued as a positive contribution by the junior high group (53%, 74%, 79% respectively; averaging 69%) and nearly the same by the senior high group (71%, 39%, 77% respectively; averaging 69%). The respective rejections of practical value were very similar; junior high (25%, 21%, 21%; averaging 22%) and senior high (23%, 23%, 23%).

Tape recordings, question g, were not deemed helpful by 47% of the junior high group and 53% of the senior high group. 26% of the junior high group and 41% of the senior high group indicated that they were helpful. 26% of the junior high group were undecided. 47% of the senior high group and 37% of the junior high group believed the questions on tape recordings, question h, to be helpful. 41% of the senior high group and 16% of the junior group deemed them of no value. The largest portion of the junior high group, 47%, were undecided as to the value of the questions on tape.

b. Teacher observation
   1) Subjective data on teacher observation.

TABLE 12

TEACHER OBSERVATION REGARDING LEARNING EXPERIENCES OF MENTAL STUDENTS IN THE UNIT ON MACHINES

A Percentage Treatment of Subjective Data

Interest		Academic Assignments		Laboratory	
Jr.		Jr.		Jr.	
slight	39%	slip-shod	23%	Dreams	32%
Average	32	Varied	51	Plays	3
Marked	29	Thorough	26	Varies	39
				Serious	26
Sr.				Sr.	
slight	22	Sr. slip-shod	39	Dreams	11
Average	39	Varied	28	Plays	17
Marked	39	Thorough	33	Varies	39
				Serious	33

3) Comments regarding teacher observation of experimental students during the unit on Machines (Table 12).

There was a smaller proportion of students with a marked level of observed interest for the junior high group (29%) than for the senior high group (39%).

Thoroughness in academic assignments was indicated for 26% of the junior high group and for 33% of the senior high group.

Teacher observation indicated that the senior high group (33%) had a greater portion of serious students in the laboratory situation than the junior high group 26%. The junior high group (32%) had more 'dreamers' than the senior high group (11%). The senior high group (17%) had the greater proportion of students classed as 'players' in the laboratory situation as compared to the junior high (3%). An equal proportion of students in each group were classed as varying (39%).

2. Unit on Insulation

a) Student reaction

1) Subjective data on student reaction to the unit on insulation for 27 junior high students and 15 senior high students.

TABLE 13

STUDENT REACTION AND TEACHER OBSERVATION REGARDING LEARNING EXPERIENCES OF EXPERIMENTAL STUDENTS IN THE UNIT ON INSULATION,

A Percentage Treatment of Subjective Data

	Interest in		Significance for daily living					tape recordings	
	Was the class about insulation interesting?	Did you like the unit on insulation?	Do you think the things you learned about insulation will help you?	Will it help you buy a better house?	Will it help you know what to do to keep a house from losing so much heat?	Will it help you know what to watch for in chosing clothing to wear in hot or cold weather?	Will it help you keep food hot or cold longer?	Did the film strips with sound help you understand insulation?	Did the film strips without sound help you understand insulation?
Jr.	a.	b.	c.	d.	e.	f.	g.	l.	m.
No	8%	16%	0	4%	4%	0	8%	8%	32%
Don't Know	12%	4%	12%	16%	16%	20%	20%	8%	16%
Yes	80%	80%	88%	80%	80%	80%	72%	84%	52%
Sr.									
No	35%	53%	40%	20%	20%	13%	20%	20%	47%
Don't Know	20%	7%	7%	0	0	7%	0	7%	20%
Yes	47%	40%	53%	80%	80%	80%	80%	73%	33%

STUDENT REACTION

Laboratory Experience as an Aid to Understanding

	Did you like the lab experiments?	Did the lab experiments help you understand insulation better?	Was the test with real things easier than it would have been if words had been used to tell how each thing was made and if there was nothing to look at?	Did you like the test with real things better than the rest of the tests?
Jr.	h.	i.	j.	k.
No	8%	4%	0	12%
Don't know	12%	28%	12%	4%
Yes	80%	68%	88%	84%
Sr.				
No	27%	40%	7%	20%
Don't know	13%	0	20%	0
Yes	60%	60%	73%	80%

2) Observations regarding student reaction to the unit on insulation (Table 13).

In the junior high group indications of interest (80%, 80%) on questions a and b, was higher than the senior high group (47%, 40%). The junior high group (8%, 16%) had a smaller percentage disliking the unit than the senior high group (35%, 53%).

On questions c through g, related to significance of material in the unit for daily living, the junior high group (80%, 80%, 80%, 80%, 72%, averaging 78%) compared rather closely with the senior high group (53%, 80%, 80%, 80%, averaging 73%).

The laboratory experience and use of concrete materials, questions h through k, were appreciated more by the junior high group (80%, 68%, 88% 84%, averaging 80%) than by the senior high group (60%, 60%, 73%, 80%, averaging 68%).

Question 1 compares the use of film strips with tape recordings with question m, the use of film strips without tape recordings. 84% of the junior high group and 73% of the senior high group indicated that the film strips accompanied by tape recordings helped improve their understanding. 8% of the junior high group and 20% of the senior high group state that the tapes with the film strips did not help improve their understanding.

In reference to film strips without recordings, 32% of the junior high group and 47% of the senior high group did not indicate that it was helpful in improving their understanding. 52% of the junior high group and 33% of the senior high group indicated that the film strips without the tape recordings did help improve their understanding.

a. Teacher observation

1) Subjective data on teacher observation of students in the unit on insulation.

TABLE 14

TEACHER OBSERVATION OF LEARNING EXPERIENCES OF EXPERIMENTAL STUDENTS IN THE UNIT ON INSULATION, A Percentage Treatment of Subjective Data

Interest		Academic Assignments		Laboratory	
Junior		Jr.		Jr.	
slight	36%	slip-shod	29%	Dreams	18%
Average	35	Varied	42	Plays	18
Marked	29	Thorough	29	Varies	32
				Serious	32
Senior		Senior		Senior	
slight	34	slip-shod	33	Dreams	0
Average	20	Varied	27	Plays	13
Marked	46	Thorough	40	Varies	14
				Serious	73

2) Comments regarding teacher observation of experimental students during the unit on insulation (Table 14)

The senior high group appeared to have more 'marked interest' than the junior high group. Teachers observed 'marked interest' on the part of 46% of the senior high group and 29% of the junior high group. 'Slight interest' was noted in 36% of the junior high group and 34% of the high school group.

The quality of academic work was considered thorough for 40% of the senior high group as compared to 29% for the junior high group. 'Slip-shod' work was noted in 29% of the junior high group and 33% of the senior high group. 'Variable' work appeared more frequently in the junior high group ; 42% as compared with 27% in the senior high group.

Activities in the laboratory situations were participated in with greater seriousness by the senior high group. The senior high group had 73% rated as 'serious', 13% classes as 'players', and none classed as 'dreamers'; the junior high group had 32% rated as serious, 18% classed as 'players', and 18% classed as 'dreamers'.

3) Comparison of observations regarding student reaction and teacher observation for the machine unit and to the insulation unit.

Comparison of student reaction for the two units

Indications of interest increased for the junior high group from 69% on the machine unit to 80% on the insulation unit. For the senior high group indication of interest declines from 53% on the machine unit to 44% on the insulation unit.

Indications noting practical value for daily living increased for the junior high group from 68% on the machine unit to 78% on the unit on insulation. The senior high group likewise increased from 50% on the machine unit to 73% in the insulation unit.

Appreciation of the contribution of laboratory experience and usage of concrete materials increased the junior high group from 69% for the machine unit to 80% for the insulation unit. The senior high group indicated 69% appreciative responses on the machine unit and 68% on the insulation unit.

Comparison of teacher observation for the two units.

'Marked interest' was considered to be identical for the junior high group on the machine unit (29%) and on the insulation unit (29%). There were only slight change in the other classifications of interest for the junior high group. The senior high group was considered to have an increase in 'marked interest' on the insulation unit (46%) as compared to the machine unit (22%).

There was a 3% increase in 'academic thoroughness' for the junior high group on the insulation unit (29%) as compared to the machine unit (26%); however there was also a 6% increase in work classed as 'slip-shod' for the junior high group (23% and 29% for the respective units.) The senior high group was rated higher in 'academic thoroughness' on the insulation unit (40%) than on the machine unit (33%); and there was a decrease in the 'slip-shod' rating on the insulation unit (33%) as compared to the machine unit (39%).

In the laboratory situation the junior high group received more 'serious' ratings on the insulation unit (32%) as compared to the machine unit (26%). Although there were fewer classed as 'dreamers' on the insulation unit (18%) than on the machine unit (32%), there were more classed as 'players' on the insulation unit (18%) than on the machine unit (3%). The senior high group indicated progress in all categories. Machine unit ratings were as follows: 'serious', 33%; 'varies', 39%; 'plays', 17%; 'dreams', 11%. Insulation unit ratings were as follows: 'serious', 73%; 'varies, 1 14%; 'plays', 13%; 'dreams', none.

CONCLUSIONS

A. Variation Factors

A major problem in action research is the identification and control of variables. In this project many variables were present: variation in class and group composition, variation in student need and interest, absenteeism, variation in teacher background and motivation, class scheduling peculiar to the program for integrating special education students into regular classes at the secondary level, availability of appropriate classrooms and equipment.

Tables 1 and 2, referring to class composition, indicate both homogeniety and lack of homogeniety between the experimental and control groups: The number and types of handicapping conditions were nearly the same. Chronological ages were quite comparable. Intelligence quotients, for those tested by Wechsler tests, were higher for the experimental groups than for the control groups. The Durrell Test of Listening Comprehension indicated results nearly the same for both experimental and control groups. Reading comprehension of the junior high and senior high control groups was slightly higher.

The junior high and senior high experimental groups obtained higher scores on pre-test inventories of understanding of the operation of simple machines, (Tables 3, 5). Pre-test results on insulation (Tables 7 and 8) indicated a somewhat higher score for the experimental group than for the control group on all four sections.

Attempts to have comparable laboratory facilities were thwarted occasionally by multiple demands made upon such facilities in part of the school buildings involved.

Frequent teacher conferences helped compensate for difference in teacher background and insured uniformity of approach.

Elaborate instructional guides and availability of identical instructional aids facilitated uniformity of approach.

B. Conclusions regarding objective data

The preceeding comments regarding objectivity have been made to preface this statement: IF the only variables between the experimental and control groups were the instructional approach THEN it could be concluded that the instructional approach pursued in the experimental group resulted in a greater gain in understanding than that of the control group. However, it must be kept in mind that, in addition to the aforementioned variables, the very small sampling, further narrowed by absenteeism limited the statistical possibilities of this study.

Nevertheless, reflected against the awareness of the variables, the limited sampling and the measures taken to control the variables, a number of indications of possibilities have evolved as a result of the project.

1. Conclusions regarding the unit on machines.

Pre-test inventory of operation of machines. Table 3 indicates that the raw scores for Mechanical Reasoning Form A of the Differential Aptitude Test were higher for the experimental group. The experimental junior high group was higher than the control junior high group. The experimental senior high group was higher than the control senior high group. The total experimental group scored higher than the total control group.

Table 5, referring to the teacher made pre-test on machines, indicates higher scores for the experimental group and its component junior high and senior high groups on both the single answer and concept level questions.

In both experimental and control junior high groups Mechanical Reasoning pre-test and teacher-made pre-test scores surpassed those of their respective high school groups (Tables 4 and 6)

Post-test gain in scoring. Results on the post-test, Mechanical Reasoning Form B of the Differential Aptitude Test (Table 4), present a mean gain for experimental groups which surpassed that of the control groups. The junior high experimental group scored a greater mean gain than did the control junior high group. The experimental senior high group registered a higher mean gain than the senior high control group. The total experimental group made a greater mean gain than did the total control group.

The experimental groups scored greater mean gains on both single answer and concept level questions in the teacher-made test on machines (Table 6). The junior high experimental group was higher than the junior high control group. The senior high experimental group had a greater mean gain than did the senior high control group. The total experimental group made greater mean gain than the total control group.

On the DAT test of Mechanical Reasoning the mean post-test gain of both senior high experimental and senior high control groups was greater than the mean gain for the respective junior high groups.

With the exception of the senior high control groups loss on the single answer part of the teacher-made post-test, both experimental and control groups at the senior high level netted greater mean gain on the teacher-made test than did the junior high groups (Table 6).

2. Conclusions regarding the unit on insulation.

Pre-test inventory on insulation (Tables 7, 8). The total experimental group was higher than the control group in mean scores on all four sections of the pre-test on insulation. The junior high experimental group was higher than the junior high control group on all four sections. The senior high group was higher than the senior high control group on all four sections. The junior high level in both groups scored lower than the high school level in each group on three of the tests. The junior high level of each group scored higher on the test that was the most abstract, (Home Insulation section, with transparencies, sketches, and multiple choice questions)

Post-test gain for the unit on insulation (Tables 9, 10). The overall mean gain for all four sections of the test on insulation was greater for the total experimental group as compared to the total control group. The experimental junior high group surpassed the control junior high group. The senior high experimental group surpassed the senior high control group on three out of the four tests. The junior high experimental group surpassed the senior high experimental group on three out of four tests. The junior high control group was lower than the senior high control group on all but one of the tests. The test that the senior high groups scored highest on was the most abstract in the series, the Home Insulation section (with transparencies, sketches, and multiple-choice questions).

3. Generalizations regarding results on objective data on the units on machines and insulation.

The total experimental group surpassed the total control group on all test sections for both units. In only one instance did the senior high control sub-group break the pattern by surpassing the experimental senior high sub-group. If there were proof that the many aforementioned variables did not influence results, it could be concluded that the instructional approach employed with the experimental group accounted for the difference. However, with elimination and/or control of concomitant variables it can only be concluded that the instructional approach is a possible factor influencing the greater gain on the part of the experimental group.

Therefore, the following null-hypothesis cannot be disproved. It can only be stated that a consideration of the objective data affords an indication of the 'possibility' that the following null-hypothesis can be disproven:

I. Retarded students exposed to a curriculum including science which has a carefully structured series of learning experiences will learn no more about science than retarded students in whose curriculum science may occasionally appear according to the current interest of the teacher.

II. Retarded students, who have teachers with access to an abundance and variety of teaching aids learn no more about science than retarded students whose teachers have access to the limited amounts and variety of teaching aids available under the usual classroom budget.

III. Due to the level of abstraction of scientific theory, retarded students cannot be taught scientific principles.

V. Limitation in ability to appreciate quantitative variation precludes retarded students from gaining an understanding of the significance of scientific principles.

VI. Limited reading ability makes it impossible for the retarded student to derive meaning from a science course.

Null-hypothesis No. IV stated:

There are no individual differences in retarded students' ability to grasp scientific principles. There was one particular section in both the test on machines and the test on insulation which was markedly more difficult and more abstract than the other sections. Individual cases were not handled statistically; however a review of group statistics indicated a possibility that senior high level students can grasp more abstract concepts than junior high students. In the concept level section of the test on machines, (Table 6) and in the Home Insulation, with transparencies, sketches, and concept-level questions (Table 9), the junior high levels of both the experimental and control groups fell below the mean gain of the senior high levels of both groups. In the unit on machines the junior high experimental group was below the senior high experimental group mean gain in all three sections; but in the insulation unit the experimental junior high group surpassed the senior high experimental group in mean gain in three out of four sections, the latter being the abstract section, Home Insulation, cited above.

C. Conclusions Regarding Subjective Data for the Experimental Group

Student Reaction to Unit Experiences, (Tables 11, 13)

Greater interest in both units was indicated by the junior high group. The junior high group increased its interest rating for the second unit, insulation, 11% over the preceeding unit; while the senior high interest rating diminished 9%. This should be considered in conjunction with the objective data which indicated that the junior high group, which made a lower mean gain than the senior high group on all three sections of the unit on machines, surpassed the senior high group in mean gain in three out of four sections of the unit on machines. This suggests the 'possibility' that interest is directly related to mean gain.

There was a very strong indication of student confidence that the content of the units was significant in regard to possibilities for practical application in situations encountered in daily living. The unit on insulation elicited even more favorable response than the unit on machines.

Both groups indicated a great deal of appreciation for laboratory experience and concrete materials as a means of helping gain an understanding of the science units studied. The senior high group indicated a slight increase in this appreciation on the second unit; the junior showed a considerable increase in appreciation on the second unit. This may have been a factor in the junior high group's surpassing the senior high group on the unit on insulation.

Less than half of the students on both levels indicated that tape recordings used in the machine unit were helpful. Approximately half of the students indicated that the tape recording did not help them understand the unit material. However, in the unit on insulation a film strip accompanied by a tape recording won a strong vote of approval as an aid to gaining understanding. Film strips without sound rated 30% to 40% lower than the film strip with tape as aid to gaining understanding. The quality of the various film strips was not evaluated scientifically but if they were comparable as they appeared to be, it would suggest that multi-sensory instructional aids are more helpful than single sensory aids.

Teacher observation of experimental students during unit experiences (Tables 12, 14)

Teacher observation of interest coincided with the pattern evident in student reaction in that the teachers rated junior high students higher in interest than senior high students in both units. Junior high students' interest increased for the second unit; both the senior high interest declined slightly for the second unit.

There was an increased percentage of students in both the junior and senior high groups classed as 'thorough' in their academic work for the second unit. In the junior high group, and to some extent in the senior high group, there was the suggestion of a pattern of relationship between 'marked' interest and academic 'thoroughness.'

Teachers observed an increased 'serious' tone in the laboratory activity of the second unit. The increase for the high school group was very marked, from 33% to 73%. An attempt to relate this increase to student interest is confused in that student reaction indicated a 9% decline in interest for the second unit, whereas the teacher observation indicated 7% increase in interest. The senior high student reaction indicating increased significance of unit material for application to daily living experiences would suggest a relationship with increased appreciation of laboratory experience.

General implications of the student reaction and teacher observation considered together.

With the exception of the senior high groups indication of less interest on the student reaction, there was an overall increase in enthusiasm for and purposeful participation in the science program as the project moved from the first through the second unit.

Generalizations and recommendations of participating experimental teachers.

As a result of their participation in the project, teachers made observations and suggestions which should be carefully considered: Teacher A -- The science units taught had concepts which were far beyond the grasp of younger students in the lower I. Q. range. There must be gradation of concepts taught geared to maturity and intelligence. Possibly science should not be attempted for students below a certain level of maturity and intelligence. Teacher C -- Interest appeared to be directly related to the mean gain of a number of students. Teacher E -- Laboratory activity won the interest of students whose interest and cooperation could not be secured otherwise. Teacher A and D--Science subjects which anticipate practical life situations beyond the maturity and interest of a child will not demand their interest and attention. Teacher E -- Some students who have had a long record of being at the lower limits of the class in reading and arithmetic surpassed many of their peers in mean gain in science. Teacher C and E -- The use of head sets with the tape recorder helped screen out distractions and focus attention. Teacher D and E-- The us of tape recordings facilitated make-up work. Teacher C and E -- Programmed learning, as employed in this project, helped reinforce learning and highlight areas in which students were confused. Teacher D -- The part-to-the-whole and concrete-to-abstract approaches worked very effectively. Teacher C and E -- Repetition with variation appeared to be very valuable. Teacher D -- Students did not consider the overall time for the unit to be too long; but there were numerous negative reactions to the two period daily schedule. Approval was indicated when the time per day was shortened.

Ramifications

The primary consideration from this point should be plans for continuation of the project on a more extensive scale. A greater number of students must be involved in order to make statistical findings more reliable. There should be study of the performance of selected types of individuals on the basis of such factors as type of handicapping condition, level of maturity, academic ability, non-academic reasoning ability, inclination toward mechanical and/or scientific reasoning, and general area of occupational preparation. Various subjects in the area of science must be adapted to the needs and abilities of the retarded student and tested operationally by using them in classroom situations. After extensive exploration of various facets of science apropos to the retarded student, areas must be reviewed for their contribution to successful adjustment of the students involved, and curricular structure for science for retarded students must be established. The curricular structure must be dynamic in that it will always seek to present material which will be significant to the student in ever-changing life situation.

As students enter the senior high level and participate in a pre-apprenticeship program in business and industry the science might well be science for warehousing, science in nursery and gardening, or science in child care and home management.

The science program must not be limited to the secondary level unless results of investigation precludes it. Every effort should be made to establish a science program having a continuity which treats concepts recurringly on progressive levels of difficulty.

Specific recommendations involve the use of instructional aids: Subjective data suggested that tape recordings were more effective when shown in conjunction with film strips; film strips were more effective when shown with tape recordings. The validity of 'teaming up' audio and visual material should be checked out for retarded students.

The laboratory approach, involving the use of many concrete materials used in the most realistic manner possible, was quite well accepted by the students in their reaction to the units. The potential of this aspect of instruction for retarded students should be investigated in greater depth.

PROJECT TITLE Construction of Vacuum Tubes in the Teaching of Physics

Gary Peterson, Dale Bremmer

STATEMENT OF THE PROBLEM

It has been the purpose of this research to evaluate a kit designed to make it possible for students to construct their own electronic vacuum tubes. This activity, not normally a part of physics instruction, would contribute to an increased depth of understanding of physics concepts.

RESEARCH PROCEDURE

In spite of the necessary refinement of the original project, a great many valuable things can be done with existing tubes, especially cathode ray tubes. Some of these tubes may be acquired as government surplus. I have obtained a special purpose Radar tube, constructed a high voltage power supply, and used it in several physics demonstrations as well as a class experiment to measure the mass of the electron.

There are many qualitative physics experiments and demonstrations requiring high voltages. Usually an induction coil can give good results. However, if anything quantitative is to be attempted, a filtered power supply with some means of controlling the output is needed. There are commerical units available but the cost is prohibitive.

The unit I have designed will give a controlled output from 1000 to 20,000 volts and costs about $25 to build. It operates in the same manner as the high voltage unit in most TV receivers, and used parts may be obtained from an old TV. The 884 tube serves to generate a sawtooth wave which is amplified by the 6BQ6GT. The current in T_1 thus builds up and then drops suddenly, producing a high voltage across the IB3 tube. The high voltage capacitor (C_6) serves to filter the output but may be omitted since the frequency of the unit is about 15 to 20 Kilocycles and stray capacitances around the circuit will provide adequate filtering.

There are several problems involved in constructing the unit since such high voltages are being generated. Corona discharge was the most serious problem encountered. Care must be taken to keep components separated, to make all solder joints smooth and clean, and to keep all leads as far away from ground as possible. I would suggest that the complete unit be assembled on plastic and buss wire used for ground connections. This will take care of most of the problems involving arcs between components and the chassis.

Corona dope will help very slight discharge problems but it should be used for prevention and not as a cure. The corona ring socket must be used for the IB3. If the work is done carefully, no discharge problems should be encountered.

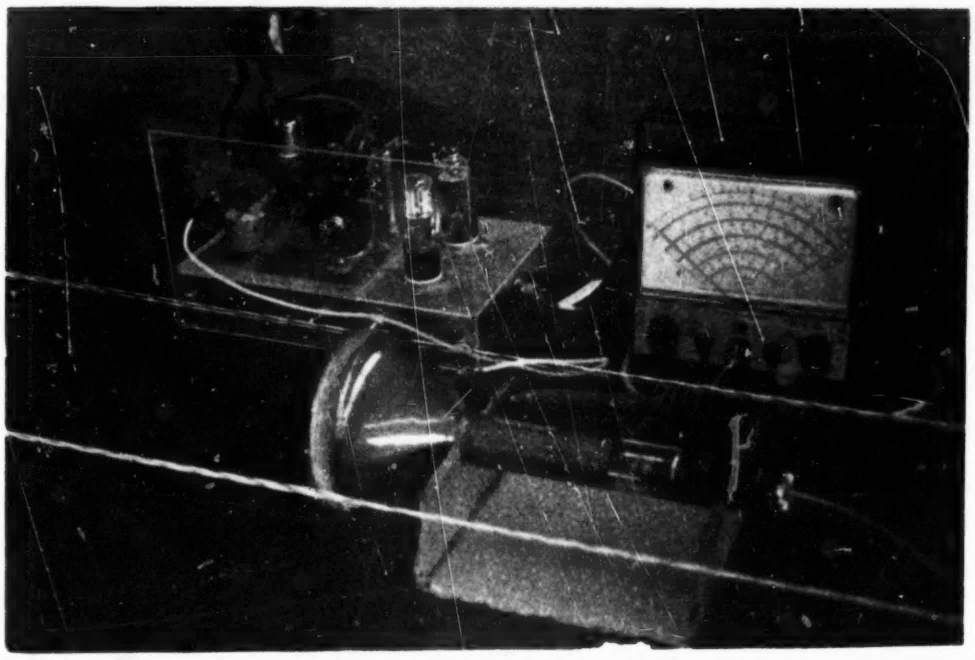
The unit was used this year to operate a war surplus CRT in classroom demonstrations and for a class experiment to measure the mass of the electron. The students became used to the complex-looking gear through daily demonstration to show simple magnetic deflection of the electron beam. This helped a good deal when it came time to make measurements with the tube to determine the electron mass. The method used was essentially the same as shown in the PSSC film on the mass of the electron. It was not possible to measure the distance from the plate to the face of the tube. However, this problem was taken care of by having the tube X-rayed at a hospital. One of my students has a father who is a doctor. I had half my students see the film and half do the experiment in lab.

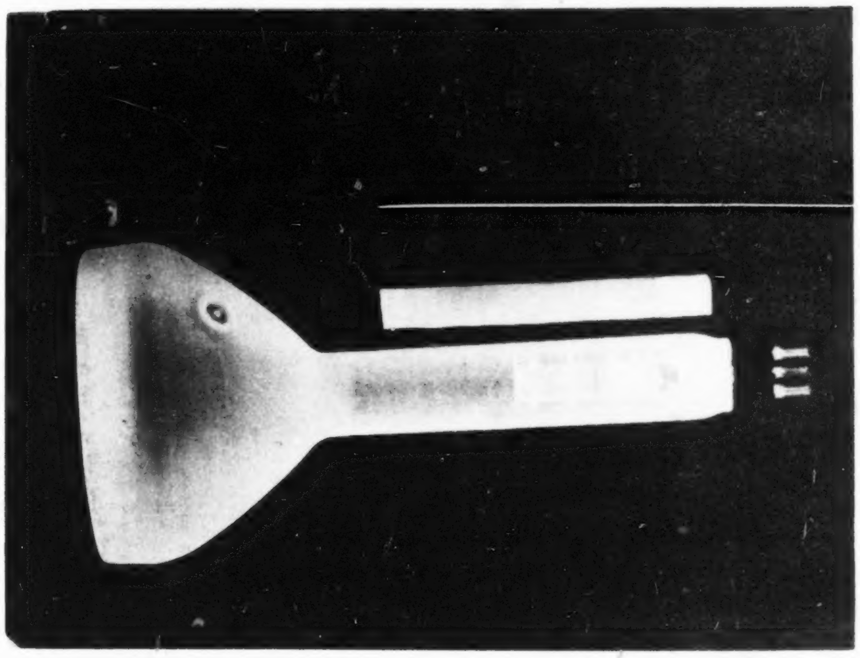
FORM OF EVALUATION

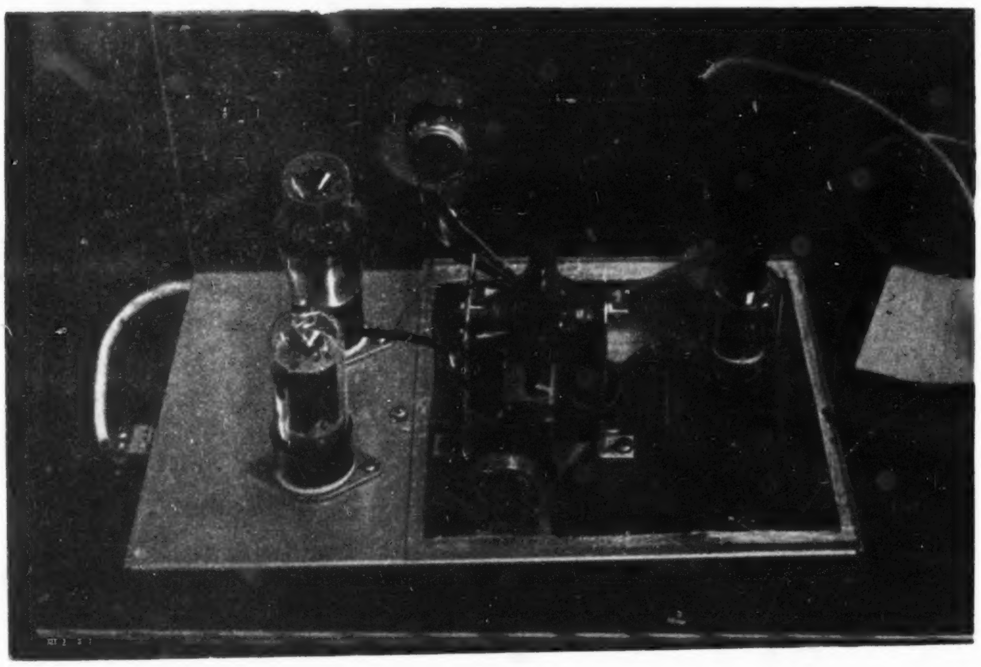
Due to the lack of satisfactory standardized test instruments in this area of physics and lack of time on the part of the instructor to construct an appropriate test instrument, I made no effort to test to see if one group learned more than the other but most of the students who did the experiment felt that they learned more than if they had seen the film. They did not mind the fact that they had 28% error whereas the film had nearly no error.

CONCLUSIONS

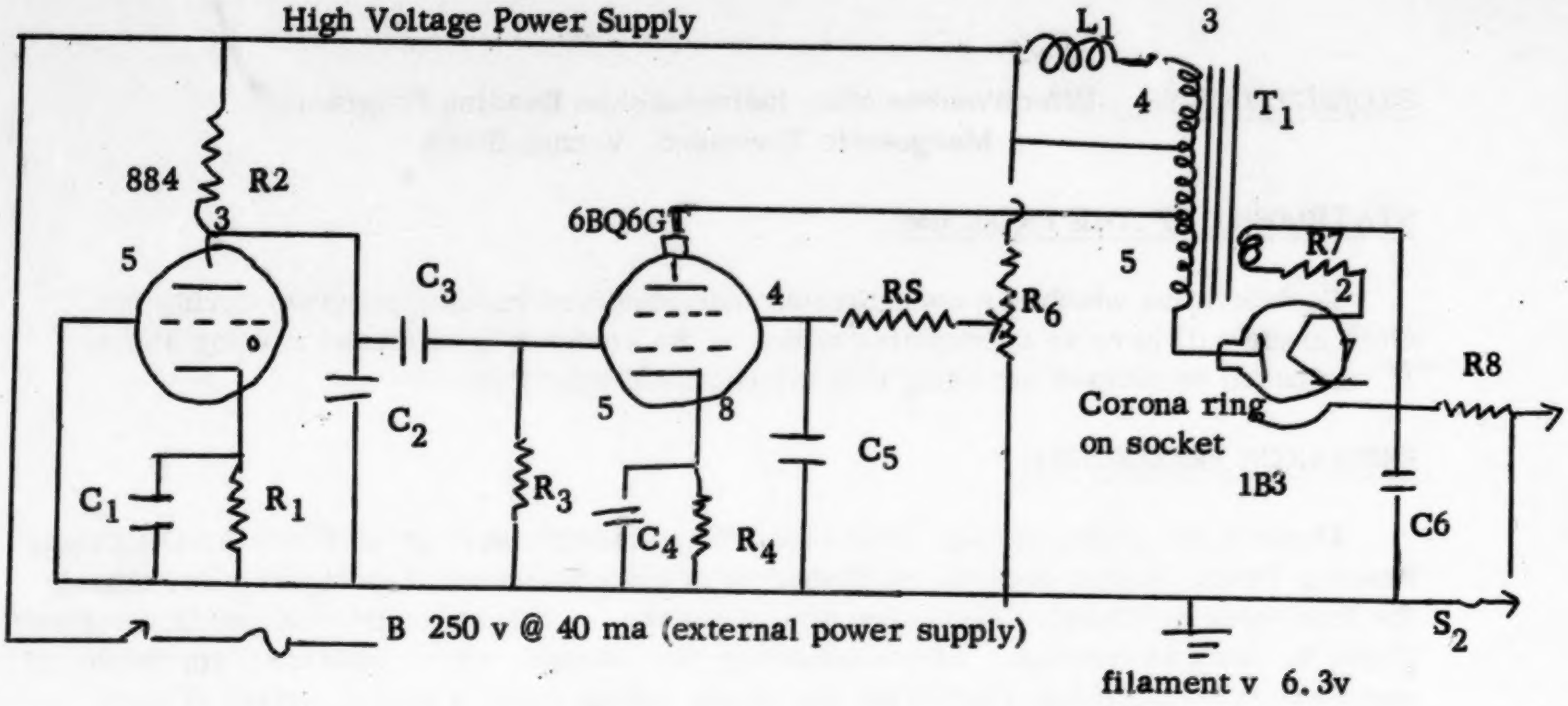
After working with the materials myself and observing some work on the same project at Colorado College, I have come to the conclusion that it is not realistic for any but the most gifted high school students to attempt construction of a vacuum tube. There is, however, a great need for a high voltage power supply in a good physics laboratory. A unit similar to the one described here would make a valuable contribution to any physics laboratory.







High Voltage Power Supply


L1
3
4
T1
884
R2
3
5
C3
6BQ6GT
4
RS
R6
5
R7
2
7
R8
Corona ring
on socket
1B3
C6
C2
5
8
C5
C1
R1
R3
C4
R4
S2
B 250 v @ 40 ma (external power supply)
filament v 6.3v

R_1	2.7K	1/2 watt - adjust for bias
R_2	47K	" watt adjust for frequency
R_3	2.2M	4 watt
R_4	270	2 watt
R_5	15K	4 watt w.w.
R_6	50K	1 watt
R_7	4	1 watt
R_8	10M	
C_1	50 uF	
C_2	.002 uf	
C_3	.002 uf	
C_4	50 uF	
C_5	.1uf	
C_6	500 uuf 20 KV	
L_1	30 mh RF choke	
T_1	Stancor A-8254 High Voltage transformer	
S_1	simple switch	
S_2	switch with red cover	

PROJECT TITLE Effectiveness of an Individualized Reading Program

Marguerite Townsend, Vernon Smith

STATEMENT OF THE PROBLEM

To determine whether a concentrated individualized reading program during the ninth grade will have an appreciable effect on the students' grades and reading ability as compared to classes not using this instructional approach.

RESEARCH PROCEDURE

Three ninth grade classes were used. The students were given Form A, Diagnostic Reading Tests, Survey Section, published by Science Research Associates, Inc. during the first week of school. They were also given the Iowa Tests of Educational Development, Form X, early in October. After conducting two classes with an individual approach and one class in a traditional routine for the entire school year, a second series of tests were given the first week in May. Form B of the Diagnostic Reading Test was given and Form Y of the ITED.

A. Number of students

The experimental classes had 19 and 35 respectively and the control group numbered 23. The classes actually had more students at all times but the above numbers are those who remained throughout the year so that two sets of test scores are available for them.

B. Time element

The program was begun the second week of school and continued throughout the year. Approximately eight months elapsed between tests.

C. Instructional techniques

The core of the individualized program was a room library of 400 paper backed volumes at all reading levels. This was introduced early in the school year and replaced the anthology which had been in use. Students were encouraged to read continuously and most students did this. No pressure was placed on reading books they did not like or enjoy. Rather, they were encouraged to replace books which did not interest them immediately with something more to their liking. Book cards were kept and all books completed were listed, as were the number of pages and the author.

A four-fold system of reporting was utilized:

a. Oral reports were made before the class by each student.
b. Students made oral reports to each other.
b. A few formal written reports were made.
c. Students designed book jackets which were displayed.

In these ways interest was created in reading the books brought to the attention of the class and the students encouraged each other.

During the first twelve weeks the Science Research Associates Reading Laboratory IIIa was used to strengthen the basic skills. The following skills were stressed: comprehension, increase in rate, vocabulary building, practice in following directions, better study habits, good spelling and evaluating and applying information. The students became highly motivated and began to read voluntarily and with more enthusiasm as the weeks passed.

In late November and until the last of January, increased emphasis was placed on correct spelling. The SRA Spelling Laboratory was used three times a week. This, too, is an individual approach with students studying the rules and practicing only with words missed on diagnostic tests. This approach enables each student to learn as much as fast as he can. A writing unit was used during this phase of the program. Both expository and creative assignments were made and students wrote two or three papers a week during this time. These were graded on the basis of content - mechanics, spelling and appearance. Every effort was made to develop in the student's pride and concern for his work.

During the second semester the SRA Reading for Understanding was introduced. This unit consists of material aimed at giving practice in reading as a tool for learning, for critical reasoning and thinking. Here again, students were tested and had many different starting levels. They kept their own records and progressed as fast as they were able. This practice consisted of three-twenty minute lessons a week.

At all times students encouraged to be reading. Even when grammar units were taught, they had a book checked out for reading when a few extra minutes were available.

The control group followed closely the course of study in the Language Arts Guide for R-1 English teachers. This consisted of grammar units, study in an anthology and spelling.

FORM OF EVALUATION

Results - Diagnostic Reading Tests, Survey Section, Forms A and B
The experimental groups averaged a 2-1 increase in rate over the control group, with scores in both comprehension and vocabulary slightly higher. The greatest increase in total score was made by the smallest experimental group. It may be worthy to note, however, that the experimental group of 35 scored slightly higher than the control group of 22.

Results - Iowa Tests of Educational Development, Forms X and Y
Composite scores varied only slightly with the experimental groups increasing by 2.37 and 2.42 to 2.0 increase by the control group. A gain was noted in Use of Sources of Information when the experimental groups averaged 3.28 and 3.73 to the control's 2.39. Students in the experimental group scored slightly higher in all reading tests; Reading of Social Studies, Reading of Natural Sciences and Reading Literature. Students in the experimental groups also scored higher in General Vocabulary.

Results Opinionnaire
More students read more and enjoyed doing it than ever before. Experiment I averaged 21.8 books per student. Experiment II averaged 24 and the control group averaged 16.5. All groups strongly agreed that they would like to participate in a similar program next year. The experimental groups overwhelmingly agreed that they enjoyed the SRA and paperback program and that they learned more about reading and literature. They were uncertain as to whether they learned more about grammar and composition due to the program, but all agreed that a great deal about these subject areas had been learned.

CONCLUSIONS

Although the differences may not be significant, the gains of the experimental group were greater than the gains of the control group on all parts of the Diagnostic Reading Test and on all parts of the ITED but one (Test 6-Reading Natural Sciences) on which the groups were approximately equal.

In a subjective evaluation, however, I feel there is much conclusive evidence of the success of the program.

1. More students read more than ever before.
2. They enjoyed doing it and in their evaluation felt they gained from it.
3. The individualized approach is a better way to handle large numbers of pupils in a classroom.
4. There has been more application to the course. More students have tried harder than in my previous experience.

5. The psychology of each student helping himself has worked with increasingly good student-teacher rapport. There has not been a serious discipline problem in any ninth grade class.
6. There has been better writing with less grammar and spelling errors. The papers have been neater. More creativeness was evident and students seemed less afraid to express themselves.
7. Increased vocabulary was evident in both speech and writing.

Ramifications

1. Students in the control group also read more than ever before. They found the forbidden library too tempting and resorted to various methods to secure books for personal reading. The librarian reported a steady demand for titles the experimental students were reading.

   It is extremely difficult for the teacher to keep from the control group enthusiasm for the program and some of her teaching techniques. When these are a part of the philosophy of the teacher, it cannot be turned off and on like a faucet.

   These two facets undoubtedly played a part in the experiment and seemed to be unavoidable.

2. The diligence displayed by the majority of students is something that should be fostered. If this is a direct result of an individualized program, and I believe it is, then effort should be made to put such a program into general use.

PROJECT TITLE The Development of a Standardized Test Instrument to Measure Student Growth in Junior High School Science

Sharon Tebow, Eldon Laidig, Lois Dunn

STATEMENT OF THE PROBLEM

The science program in the junior high schools of Jefferson County is a sequentially organized approach which involves concepts and content of greater scope and depth than most junior high school science programs. Therefore, there is at the present time no adequate means of evaluating the effectiveness of the county-wide junior high school science program. To date, individual teacher tests, along with the results of the appropriate portions of such standardized tests as the ITED, have been used as a basis for evaluating the content and level of the curriculum.

Some evaluative device or instrument is needed to indicate the proper content of the curriculum and to determine the growth of the students in the Jefferson County Science program. Our intent has been to construct a battery of tests to be used at the junior high level to achieve these purposes. We have proposed to construct a conceptual test for each grade level, 7, 8, and 9. The content of these tests is to be based upon the curriculum for that level. When completed the tests are to be given annually, pre- and post, to determine growth of concepts of the students.

RESEARCH PROCEDURE

Our proposal called for the construction of a conceptual test of at least fifty questions at each of the junior high school grade levels. Subsequent to construction, these were to be submitted to all Jefferson County junior high school science teachers. These teachers will evaluate the questions and answers by weighing the value of each possible concept. On the basis of this the values for the concept levels can be determined and working copies of the tests can be obtained.

In attempting to carry out the research proposal, we determined to begin with the seventh grade curriculum. At the time we felt this body of material would be the easiest to work with and would be a logical starting point. As the year progressed it became obvious to us that the construction of test items on the basis we desired was quite difficult and that the seventh grade curriculum, which is largely descriptive, was very difficult to adapt to the type of items projected. At the same time it was apparent that we could not construct tests on all three grade levels in the school year of 1961-1962. We have confined our efforts to the seventh grade and intend to move into at least one other grade during the summer months and the next school year.

We have, at the present time, completed a draft of the seventh grade instrument. This has not yet been submitted to the junior high science teachers of Jefferson County. We intend to have it ready for an early distribution in the fall with revisions being made in time to permit administration to all incoming seventh graders by December, 1962. In order to make the draft submitted in the fall as refined as possible, we have administered the test to all seventh grade students presently at Drake Junior High School. As a result of this administration we hope to make a preliminary determination of the difficulty of the test items, to determine if all multiple choice items are working, and possibly to obtain some indication of the discrimination of the items. This will permit a more refined instrument for submission to the teachers in the fall.

FORM OF EVALUATION

No research data is available at this time, as all tests are in the planning and construction stages.

We propose to standardize the tests as they are administered and attempt to determine validity and reliability.

CONCLUSIONS

We have no conclusions based upon objective test data, but have reached some subjective conclusions. First, the project has proved to be even more difficult than we believed. This is probably typical of the optimism of a new school year. Second, even though we have not accomplished all that we had hoped, we are more than ever convinced of the need for the instrument and for teachers to assist in its preparation. We have become much more aware of the possibilities and of the weakness of well constructed tests or poorly constructed tests, and have probably reflected this in our own work with evaluating students.

Ramifications

Our project will require another two years to complete. The instrument for the seventh grade should be in final form by early fall and thus may be used for pre and post tests, although the pre-test will be somewhat late. On the basis of our experience the preparation of the next two tests should proceed somewhat more quickly. We plan to have the eighth grade instrument ready for administration by late in the 1962-1963 school year and the ninth grade ready for administration in the fall of 1963. Statistical analysis and evaluation of the curriculum would be made as information becomes available. This presumes the continued interest and support of the Jefferson County School District.

PROJECT TITLE Effectiveness of the Controlled Reading Technique and Reading Improvement
Adele Bond, Vernon Smith

STATEMENT OF THE PROBLEM

This experiment was in the field of reading improvement. The course was designed for those students who possess reading disabilities. The main purpose was to determine whether or not there is any appreciable increase in learning by using the Controlled Reader with such students as opposed to the utilization of other teaching techniques in reading with comparable students.

RESEARCH PROCEDURE

The experiment involved two comparable eighth grade classes of approximately thirty students each. The groups were comparable in terms of size, sex ratio, age, subject matter achievement, and reading level.

Each group had access to the same reading materials. However, in the experimental group the Controlled Reader was used to supplement instruction.

The supplementary instruction utilizing the Controlled Reader, began December 5, 1961, and ended May 4, 1962. There was a total of thirty-nine (39) full forty five (45) minute periods devoted to this type of instruction with the experimental group.

In the control group, the identical amount of time was spent on book centered instruction. From time to time, as the need became apparent, the group was broken down into small units for the purpose of developing a certain skill or strengthening a weakness.

FORM OF EVALUATION

The Henmon-Nelson Tests of Mental Ability Grades 6-9 Form A.

I.Q. Medians Control Group 92 Experimental 86

Diagnostic Reading Test Survey Form A. (administered prior to the research study)
Diagnostic Reading Test Survey Form B. (administered at the close of the research study)

General results
Experimental group
1. This group read thirty more words at the conclusion of the study than at the beginning.

2. There was a 3% increase in general comprehension.
3. There was a 2% average increase in vocabulary.
4. The overall picture indicates a 3% increase in all areas tested.

Control group

1. This group read seventy nine more words at the conclusion of the study than at the beginning. (This fact is felt to be invalid as students recorded information incorrectly.)
2. There was a 4% increase in general comprehension.
3. There was no general advancement in vocabulary.
4. The overall picture indicates a 3% increase in all areas tested.

At the conclusion of the research study, the students filled out an opinionnaire. According to this, the majority of students in both groups felt that they learned how to read better. However, in the control group there were more students that were uncertain about their reading progress. The experimental group had had concrete evidence as to their progress as they kept records which indicated their rate and scope of learning.

CONCLUSIONS

I feel that the test results of this study are inconclusive primarily because of the time element. It is my thought that we did not use the Controlled Reader for a long enough period of time. Therefore, the real benefits of this mechanical instrument have not completely revealed themselves.

There are, however, some general inferences that may be drawn from this study.

1. There is no unequivocal evidence that a Controlled Reader is essential to a successful reading program or that the results obtained cannot be achieved by other means.
2. In vocabulary development, the experimental group was superior. This probably indicates that vocabulary introduction and drill were better received by this group as they recognized the importance of knowing the words before they were encountered in the story.
3. There was a greater increase in the comprehension area among the control group. I think that this indicates that a book centered program is very important in developing and strengthening comprehension. This could mean also that the pressure method which is a part of the controlled reading technique is not appropriate for students whose basic difficulty is comprehension and critical thinking. Nor perhaps is it suitable for those students whose slow reading rate is symptomatic of an underlying emotional problem.

In regard to my own personal observations, I noticed that for students who had mastered the basic skills of word recognition and comprehension, there were several values.

1. It encouraged simultaneous reading and comprehension.
2. It provided students with concrete evidence that they could read faster, and that improvement was possible.
3. It helped in developing the skill of rapidly associating words and meanings without vocalization.
4. It helped to develop and improve the focusing of attention.
5. It helped in developing concentration.
6. It provided practice in reading thought units.
7. It was helpful in shaking some students out of unnecessarily slow reading habits.
8. In some cases, it was helpful in developing and improving physical and mental coordination.
9. Students were enthusiastic and receptive to this type of supplementary instruction. To them it was a new approach and they seemed to find it refreshing and stimulating.
10. I think that in a remedial reading program, the Controlled Reader has a definite supplemental place.
11. I feel that possibly I did not allow adequate time for counseling and guidance. in the experimental group. This, I think, is so very helpful in solving many of the inner conflicts which seem to interfere with effective reading.

Ramifications

I do not believe that there are any obvious curriculum implications in this particular study. However, I am planning to continue using the Controlled Reader as a supplementary instructional aid. I hope over a longer period of time that I can gather more specific data as to its effectiveness.

PROJECT TITLE Remedial Reading - History Content Approach to Reading Improvement and Increased Learning in History

Margaret Brown, William Lewis, Dale Osterman

STATEMENT OF THE PROBLEM

Many low placement group students have reading problems which affect all of their study habits. In view of this fact, the World History and developmental reading teachers at Lakewood Senior High School proposed to combine efforts in development of remedial reading units of history content and the use of commercially available remedial reading material. It is felt that this joint effort will result in greater achievement in History on the part of students who have previously experienced difficulty in learning.

RESEARCH PROCEDURE

We involved all ninety-one low placement World History students at Lakewood Senior High School in the experiment. The group of ninety-one was divided into two groups. The morning group consisting of thirty-seven students served as the experimental group and the afternoon group of fifty-four students served as the control group. These groups were not even in number due to scheduling problems.

The experimental group spent one-half of their time in a reading improvement program and one-half of their time in the World History class.

A. Time span covered by the research.

The time span covered by the investigation involved regular class periods for nine weeks. The experimental group periods were divided as follows: twenty-five minutes, reading; twenty-five minutes, history class; and five minutes allowed for passing.

The control group had a regular fifty-five minute period in World History.

B. Instructional techniques used.

The reading procedure used was aimed at increasing the rate of reading and comprehension of these students in World History material with the use of the Tach-X and the controlled reader. Study methods and vocabulary were also emphasized.

The study method as set forth by the SRA Reading Laboratory involved the five following steps: survey, question, read carefully, review, and recite were used.

Vocabulary lists were prepared by the history teacher. The reading teacher emphasized spelling, root words, meaning, and the use of words in sentences.

FORM OF EVALUATION

A. Attached are the reading records of the experimental group.
B. The I.Q. scores for all low achievement students.
C. Standardized test results both pre and post for both the experimental and control groups.
D. Teacher constructed test results both pre and post for both the experimental and control groups.
E. Daily report on reading activities and the instructor's comments.

Reading Records for Experimental Group

Student	12/4	12/11	12/22	1/12	1/17	1/24	1/25	1/26
1	158	180	200	dropped out of school				
2	125	144	144	147	210			
3	175	162	140	200	210			
4	158	180	ab	147	189			
5	158	180	200	ab	189			
6	105	ab	ab	ab	147			
7	ab	144	160	189	189			
8	105	144	180	189	168			
9	123	108	180	189	189			
10	122	ab	160	168	ab			
11	105	144	180	168	189			
12	105	126	180	126	210			
13	140	126	180	ab	189			
14	88	ab	100	147	ab			
15	123	162	ab	147	189			
16	70	108	140	126	164			
17	158	162	200	189	189			
18	123	180	180	189	189			
19	140	180	140	168	168			

Reading records (con't)

Student	12/4	12/11	12/22	1/12	1/17	1/24	1/25	1/26
20	88	108	60	105	126			
21	140	144	200	189	189			
22	123	144	ab	168	147			
23	105	162	200	ab	210			
24	158	162	ab	210	210			
25	140	162	160	ab	147			
26	88	144	200	210	189			
27	88	180	180	210	189			
28	140	ab	160	168	210			
29	123	126	160	147	189			
30	140	90	140	189	189			
31	123	108	ab	189	147			
32	70	162	100	168	147			
33	140	162	160	160	ab			
34	175	126	200	dropped				
35	175	162	180	210	189			
36	105	126	180	168	189			

TABLE 1
Experimental Group - Composite Statistics

Student	I.Q.	Pretest ITED No. 1	Pretest ITED No. 5	Teacher constructed pretest - % age 100	Retest ITED No. 1	Retest ITED No. 5	Teacher constructed retest
1	93	59	32	30			w/d
2	113	83	70	74		48	85
3	111				75	71	76
4	96	36	39	50	33	48	88
5	113		80	72	70	61	
6	95	43	12	39	56	33	
7	106	43	32	48	48		79
8	106	18	45	49	56	16	49
9	90	43	19	46	48	6	79
10	101		70	64	48	71	94
11	97		1	35	1	11	73
12	110	66	65	44	70		91
13	88	36	52	42	20	33	70
14	96		7	54		16	w/d
15	117	98	98	64	97		82
16	89	43	32	53	70	16	67

TABLE 1 (cont'd)

Experimental Group - Composite Statistics

Student	I. Q.	Pretest ITED No. 1	Pretest ITED No. 5	Teacher constructed pretest - % age 100	Retest ITED No. 1	Retest ITED No. 5	Teacher constructed retest
17	98	36	75	44	70	54	82
18	81	36	32			48	79
19	89		32	49	2	16	97
20	96	66	80	48	33	29	67
21	96	66	80	48	70	77	85
22	92	18	12	29	33	33	97
23		78	45	58	75	41	97
24	107	51			75	41	85
25	96	36	45	38			
26	107	59	39	36	63	33	61
27	107	29	19	37	12	11	73
28	108	18	19	42	33	23	76
29	101	43	39	50	40		79
30	67	23	12	54	33	23	88
31	81	29	7	34	16	16	67
32	100	36			40	23	

TABLE 1 (cont'd)
Experimental Group - Composite Statistics

Student	I. Q.	Pretest ITED No. 1	Pretest ITED No. 5	Teacher constructed pretest - % age 100	Retest ITED No. 1	Retest ITED No. 5	Teacher constructed retest
33	101	66	75	57	33	71	
34	85	72	75	42			
35	99	89	75	54	93	67	
36	109	36	32		56	33	82

TABLE 2

Control Group - Composite Statistics

Student	I.Q.	Pretest ITED No. 1	Pretest ITED No. 5	Teacher constructed pretest - % age 100	ITED Retest No. 1	ITED Retest No. 5	Teacher constructed retest
1	81		19	50			44
2	102	36	52	44	48	11	64
3	92	23			63	41	58
4	88	51	39	50	33	33	ab
5	105	72	19	40			58
6	93	8	19	26			56
7	96	59	39	ab	70	33	78
8	101		3	26	40	16	44
9	115	59	45	50			ab
10	98	94	80	66			ab
11	86		12	ab	1	29	ab
12	102	18	39	60	20	54	80
13	83	59	32	ab	40	41	80
14	105	51	52	34	33	41	48
15	89	86	52	47	63	41	ab
16	85		1	38		3	66

TABLE 2 (cont'd)

Control Group - Composite Statistics

Student	I.Q.	Pretest ITED No. 1	Pretest ITED No. 5	Teacher constructed pretest - % age 100	ITED Retest No. 1	ITED Retest No. 5	Teacher constructed retest
17	116	23	26	28			w/d
18	106	59	19	75	49	29	86
19	104		19	38	26	2	68
20		59					
21	86	86	45	59	56	67	78
22	109	18	12	34	5	6	56
23	105	59	45	34	26	11	60
24	128	59					w/d
25	104	51	12	48	9	29	96
26	111	66	75	44	56	41	76
27	109	36	45	46		33	86
28	81	23	12	42		11	90
29	86	89	45	42	88	16	88
30	77		19	32	40	16	60
31	95	14	12	32	20	29	58
32	108	39	42	42		29	66
33	90	18		41			w/d

TABLE 2 (cont'd)

Control Group - Composite Statistics

Student	I.Q.	Pretest ITED No. 1	Pretest ITED No. 5	Teacher constructed pretest - % age 100	Retest ITED No. 1	Retest ITED No. 5	Teacher constructed retest
34	69	2	26	26	20	11	36
35	108	32	48	48	2	6	w/d
36	91	14	4	41	20	16	68
37	89	72	45		40	16	86
38	94	51	26	51		6	
39	111	51	52	40		40	70
40	99	59	84	40	20	29	92
41	88	1	26	16	1		48
42	68	10	32	36	33	6	80
43	105	43		37	1	16	84
44	107	43	32	23	16	23	58
45	89	43	52	68	88	61	78
46	104	59		44	63	29	66
47	109	59	52	45	40	41	84
48	108	66		48	40	29	68
49	96	23	26	40			76
50	96	66	39	51		16	

DAILY REPORT OF READING ACTIVITIES: WORLD HISTORY-READING FELS STUDY

Nov. 22, 1961: Began Tach-X training and explained objectives. 4ND #1, at 1/10 sec. Controlled Reader #1, "It's Fun to Read." 150 wpm.

Nov. 27, 1961: 4ND, B speed (20 exposures). Explained record books, CR "Great Chicago Fire," 100 wpm.

Nov. 28, 1961: 4ND A speed (15 exposures). Vocabulary for Chapter Ten, World History, p. 67 of record book. SQ3R method of study introduced. Pp. 174-179 of history book.

Nov. 29, 1961: 4NL, B speed. Vocabulary sentences using words from Chapter Ten; introduced words from Chapter Eleven. Review SQ3R study method.

Nov. 30, 1961: 5NL, B speed. Vocabulary review, Chaps Ten and Eleven. SQ3R for history assignments suggested as review for test.

Dec. 1, 1961: Test in World History.

Dec. 4, 1961: 5NL, (0)2 B speed, CR "Thanksgiving," 175 wpm.

Dec. 5, 1961: W(71)1 "C" speed. SQ3R on World History assignment. Vocabulary, Chap. twelve, introduced.

Dec. 6, 1961: Words, 7L, "B", W(7L)5, vocabulary from chapter twelve, SQ3R. Assign: to bring five questions on chapter twelve to discuss.

Dec. 7, 1961: W(7L) 5 B, write synonyms, discussed questions students brought, assign: bring five sentences using chapter twelve vocabulary.

Dec. 8, 1961: W(7L)6 B and synonyms, introduced chapter fourteen. Vocabulary and go over student sentences.

Dec. 11, 1961: Review vocabulary for six weeks test, review SQ3R method of study for test review. CR "Owl Creek," 180 wpm.

Dec. 12, 1961: TX W (7L)7 B, synonyms, review all vocabulary for chapters twelve and fourteen.

Dec. 13, 1961: Six-weeks test in World History.

Dec. 14, 1961: Small groups in World History.

Dec. 15, 1961: Small groups in World History.

Dec. 18, 1961: Large groups in history for Renaissance orientation.

Dec. 19, 1961: Large groups.

Dec. 20, 1961: W(7L)8 B and synonyms, SQ3R, chapters 15, pp. 251, 259, vocabulary for chapter fifteen.

Dec. 21, 1961: Telephone numbers,C speed, SQ3R, Renaissance chapter.

Dec. 22, 1961: Telephone numbers, C speed, double reel CR, "The Canterville Ghost", 200 wpm.

Jan. 8, 1962: Small groups.

Jan. 9, 1962: School dismissed.

Jan. 10, 1962: Only twenty students present due to inclement weather. TX W(8L)1, C speed and synonyms, review SQ3R. Mr. Osterman took remaining twenty minutes.

Jan. 12, 1962: 5NL C. CR, "Stalked by a Grisley", 210 wpm, (a line at a time).

Jan. 15, 1962: 5NL D speed, review chaps. 15-16 for vocabulary, pictures, maps, questions.

Jan. 16, 1962: Test over Renaissance and Reformation.

Jan. 17, 1962: Phrases - Jr. H (4L)1 B, CR Jr. H. #41, "Discovery of Anaesthesia" 210 wpm.

Jan. 18, 1962: History review full period.

Jan. 19, 1962: Same as above.

Jan. 22, 1962: Review all vocabulary for semester.

Jan. 23, 1962: Semester test.

Jan. 24, 1962: Students in reading full period. T X - 6NL C, CR "How to Build a Better Memory", 225 wpm.

Jan. 25, 1962: 6NL B "Always He Is Alone" 240 wpm, study skills lab.

Jan. 26, 1962: Jr. H. (4L)2 B, phrases, "How to Cure Insomnia," 240 wpm, study skills laboratory.

CONCLUSIONS

A. Based on standardized test results.

The students in both the experimental and control group seemed to score lower on the post-test using the ITED than they did on the pre-test. The post-test was given at a very difficult time; however with nine weeks tests being given in other classes and much more extra-curricular activity going on.

B. Generally speaking the students received higher marks on the teacher constructed re-test in both the experimental and control groups.

C. Below is a chart showing the number of students whose retest ITED scores were higher, lower or the same and the Teacher Constructed Retest results.

Experimental	Retest ITED	Higher	Lower	Same	Teacher Constructed Retest
37 students	#1	10	15	3	Higher
	#5	11	21	2	31
*If first test score was within 5 points of second test score they were counted as being the same score					Lower
					1
					Same
Control					0
54 students	#1	10	4	11	Higher
	#5	7	13	6	21
					Lower
					0
					Same
					1

*NOTE: The scores of the Experimental group, as compared to the Control group, had a greater significance in that: (1) the scores marked "Down", or "lower" in the Experimental group were much closer to the Pre-test ITED scores than those of the Control group; and (2) the scores marked "Higher" in the Experimental group were higher than those of the Control group.

D. Student attitude toward History seemed to improve noticeably in the experimental group. The students attended class much better prepared during and after the reading improvement instruction.

E. Students in the experimental class came in after school more often than did the control students for additional help.

F. The day-to-day assignments covered essentially the same material for the experimental and the control group. Starting at the beginning of the experiment the two groups were faily close to each other in scores; however, as the experiment continued the experimental group consistently received higher test scores.

G. With the number of variables such as class size, time of the classes, and shortness of the experiment we feel inadequate in making any firm statements dealing with the statistical significance of the reading improvement experiment.

Ramifications

A. Curriculum implications.

It seems to us that based upon the results of our World History Reading Improvement Experiment that students do improve their study habits and that this type of research could be used in all academic subjects.

B. Next steps.

Further experimentation is needed with more of the variables controlled.

General statements by the teachers involved

Teacher A. The program appeared to be successful in that students who were subjected to reading improvement instruction improved in their regular history studies.

Teacher B. Remarkable improvement appeared in reading records and students became eager to improve.

Teacher C. The attitude of the Experimental Group toward World History improved to such a great extent that it was much more enjoyable for them as well as the instructor.

PROJECT TITLE Isometric Training Approach in Muscle and Body Development

John Hoskins, Melbourne Schwartz

STATEMENT OF THE PROBLEM

To compare the effects of isometric lifting to conventional lifting upon the development of strength in the individual. Isometric lifting is putting resistance against an immovable object. Conventional lifting is the use of barbells and dumbells.

RESEARCH PROCEDURE

A. Particular instructional techniques used: **The research section was provided with a detailed explanation of the effects of weight lifting upon the body.** weight lifting upon the body. Then the new isometric theory was explained to them.
A strength test was chosen and administered to every student in the class. The strength test used was the McCloy Classification Index. The formula for this is: CI = 20X age (in years) + 6 X height (in inches) + weight (in pounds).
This index separates the boys into classes running from A-H. When the student performs, the instructor checks his results in the column of the class of which he is a member. Three tests were used, the dip test (tests for arm extensors and deltoids), the chin test (biseps tested primarily), and the jump and reach (a test for leg strength in the extensors.)

B. Number of students used: The group using the isometric lifting was called the experimental group and consisted of nine students. The group using the conventional weight lifting program (barbells and dumbells) was called the control group and also consisted of nine students.

C. Time span covered by the experiment: On February 26 the experiment was explained to the students. On February 27 they were tested. March 1 they began their program, this continued until May 18. This made the entire program last twelve weeks. Eleven weeks were devoted to lifting with an average of two lifting sessions per week.

D. Other pertinent factors peculiar to the project: Concentration had to be learned by the experimental group in order to work the desired group of muscles. The boys soon learned this technique and said it helped them in other areas. The isometric lifting was done mostly on an isometric rack made by the Hoffman Company. The same types of lifts were used that the conventional controlled group used, except the experimental (isometric groups) used a bar that did not move as opposed to the barbells and dumbells.

FORM OF EVALUATION

A. Standardized Test Results - The higher the score determined by the index the better, or stronger the individual. The experimental group on the pre-test scored an average of sixty-three, the controlled group had an average of sixty-one. The post test showed sixty-seven for the experimental group and sixty-three for the control group. This shows that the experimental group improved somewhat over 6% while the controlled group improved 2%.

CONCLUSIONS

A. Conclusions based on the test data.
By the time our equipment arrived the boys in both groups had already been subjected to a physical fitness program. The teacher did not expect to see a great change in improvement but the experimental group using the isometric lifting developed bodies that were stronger than the conventional group, and in less time.

B. Conclusions based on subjective observation.
The isometric group on certain days finished their workout before the other group and were more refreshed after the workout.
Strength is more easily retained through the use of isometric lifting.

Ramifications

A. Curriculum implication.
A definite improvement of strength was recorded by the experimental group. We supplemented this isometric lifting with another physical education class not being tested. They enjoyed it and it was easy to supplement into the program. My suggestion is to include isometric lifting into the conventional program and not replace it. The next step will explain this feeling.

B. Next steps
I believe isometric lifting helps the strength of an individual but does not necessarily improve his endurance which the conventional weights definitely help. Therefore, in the future, I would like to test the effects of isometric lifting on endurance.

Pre-test Strength Tests
McCloy Classification Index

Student	Age	Height	Weight	Index	Chins		Dips		Jump Reach		Score
					No. done	Points	No. done	Pts.	Hgt.	Pts.	
Experimental	15	71	187	H	8	18	13	20	24	23	61
	15	70	140	G	18	24	21	25	22	21	70
	15	66	124	F	12	20	13	21	17	16	57
	16	72	141	H	13	22	16	22	24	23	67
	16	66	150	G	12	21	15	22	16	15	58
	15	70	137	G	15	22	18	24	20	19	65
	15	68	129	F	7	17	13	21	24	24	62
	15	69	149	G	15	22	24	26	23	22	70
	15	72	147	G	10	19	13	24	16	15	58
									Total	points	568
									Average		63
									% Improvement		2%
Control	15	67	141	F	9	18	20	24	16	15	57
	15	67	125	F	13	21	27	26	20	20	67
	15	66	117	E	17	24	17	24	17	18	66
	15	69	131	F	5	15	12	20	19	19	54
	15	67	154	G	11	20	24	25	18	17	62
	17	66	121	G	14	22	21	25	16	15	62
	15	63	106	E	7	18	17	24	15	16	58
	16	69	161	H	9	18	26	26	16	14	58
	15	65	99	E	10	20	12	21	20	21	61
									Total	points	545
									Average		61
									% Improvement		6%

Post-Test Strength Tests
McCloy Classification Index

Student	Age	Height	Weight	Index	Chins		Dips		Jump Reach		Score
					No. done	Points	No. done	Points	No. done	Points	
Experimental				H	8	18	16	22	25	24	64
				G	21	28	24	25	21	20	73
				F	17	23	19	23	17	16	62
				H	15	23	17	23	28	27	73
				G	12	21	17	23	17	16	60
				G	19	25	23	25	21	20	70
				F	10	19	17	23	24	24	66
				G	19	25	23	25	24	23	73
				G	11	20	18	24	20	19	63
									Total Points		604
									Average		67
Control											
				F	13	21	21	25	18	18	64
				F	15	22	25	26	18	18	66
				E	19	25	25	26	18	19	70
				F	7	17	15	22	18	18	57
				G	15	22	23	25	20	19	66
				G	15	22	22	25	18	17	64
				F	13	21	17	23	18	18	62
				H	9	18	22	25	15	13	56
				E	10	20	10	20	20	21	61
									Total Points		566
									Average		63

PROJECT TITLE Research in Increased Cardiovascular Efficiency Through
Use of Weighted Jackets, Wrist Weights, and Weighted Spats
John Hoskins, Melbourne Schwartz

STATEMENT OF THE PROBLEM

To study the effects of weighted vests and weighted shoe spats in running, as compared to conventional running, upon the heart and performance of the body.

RESEARCH PROCEDURE

A. Particular instructional techniques used.
The first period physical education class was used. The experiment was explained to the class. The Harvard Step Test was chosen as the test to be used to evaluate the group. The test is run for 5 minutes with the students alternately stepping up and down off a 30" high bench at a 30 step per minute pace. The resting phase was recorded then the recovery pulse was recorded 1-1 1/2, 2-2 1/2, 3-3 1/2, seconds after the exercise. Two weeks was spent in teaching the students how to take the pulse (from the carotid artery), practicing the Harvard Step Test, and two trial tests. The test was given February 16, and the running with the spats and weights began February 19.

The two groups were equated by the Harvard Step Test. The formula: Physical Fitness Score $\frac{\text{duration of test in seconds x 100}}{\text{2 (Sum of recovery pulse rates)}}$ was used.

Split differences were used to equate the group from the index score. For example, No. 1 went with one group, 2 & 3 went with the other group. Then I altered through twenty two students. Group 1 was designated the experimental group and they ran the same amount as group two except they had the weighted vests and spats. Group 2 was designated the control group and ran the same as group one, but without vests and spats.

B. Number of students involved.
Twenty two students were used, and because of injury, this was cut to eighteen students. This meant that each group had nine students.

C. Time span covered by the research.
February 12 started the indoctrination. February 16 the Harvard Step Test was administered. February 19 the running began. We stopped the running May 18 and tested May 23. This made 14 weeks with actually 13 weeks devoted to running.

D. Other pertinent factors peculiar to the project.
We used Don Canham's weighted vest totaling 11#. This was broken down into 4 - 2 1/2# weights and 1# for the vest. We used the Magregor weighted spats totaling 3#. This is broken down into the spats, 1#, and 10 - 1/4# lead tubes that were inserted into the spats.

The first week we used 2 lead tubes on each side of the spat, then added one to each side per week, until a total of 10 were used. Then the vests with 5# were used for two weeks, then the other 5# were inserted. The last 3 weeks had every bit of equipment on them or a total of 17#.

FORM OF EVALUATION

A. The pre test using the Harvard Step test revealed the resting pulse of the experimental group to be 80 and the control group to be 76.4. The post test found the experimental group with a 78 average resting pulse and the control group 77.4. These results seem to indicate an improvement for the experimental group, no improvement for the control group.

The index of heart performance in the recovery stage after the test was administered and found the experimental pre-test to be 41.2 as compared to the control group's 40.7. The higher the number the more efficient the heart. The post test found the experimental group with a 44.3 and the control group with a 42.5. This appears to indicate that the experimental group improved about 8% while the control group improve about 4%, in overall heart improvement. The experimental group showed about 4% improvement in resting pulse and a 5% improvement in immediate recovery rate over the control group. I also used the AAHPER Physical Fitness test as a comparison of results of weights upon performance. I will list the evens and then give the pre and post test results.

(Coordination plus leg strength)	Shuttle Run	Experimental	Pre - 10.4	Post 9.8	6% improved
		Control	Pre - 10.3	Post 9.8	5% improved
(Leg extensors)	Standing Broad Jump	Experimental	Pre - 6'2"	Post 6'11"	12% improved
		Control	Pre - 6'7"	Post 7'3"	10% improved
(Leg Strength)	50 yd. dash	Experimental	Pre - 7.5	Post 7.1	6% improved
		Control	Pre - 7.1	Post 7.0	1% improved
(Endurance)	600 yd. run	Experimental	Pre - 1:50	Post 1:39	11% improved
		Control	Pre - 1:52	Post 1:46	6% improved

CONCLUSIONS

A. Standardized Test Results - The standardized test was the Harvard Step test which is based upon an index determined by how quickly the heart recovers after severe exercise. The experimental group started with an average of 41.2 and ended up in the post test with a 44.3 or 8% improvement. The control group without the use of weights started with 40.7 average and ended with a 42.5 or a 4% improvement.

In conclusion, the Harvard Step test shows the experimental group, using the weighted vest and spats appears to have developed a more efficient heart than the control group not using the weights.

B. Specially constructed Tests - The specially constructed test was four items chosen from the AAHPER Physical fitness battery of tests. These four included the shuttle run (to test coordination, leg strength and endurance), the standing broad jump (to test leg extensors), the 50 yard dash (leg strength) the 660 yard run (to test endurance, muscular and cardio-vascular). The experimental group made more improvement in all four areas than the control group.

In conclusion, it would appear that the experimental group using the weighted vests and spats gained efficient bodies for performance than the control group which did not use the weighted vests and spats.

Ramifications

A. Curriculum implication
Without a sacrifice in time or additional instruction a physical education program utilizing weighted vests and running spats can assist in developing a student with a more efficient heart and a body capable of more efficient performance.

B. Next steps
The next step is to supplement this equipment into our program and alternate the groups part way through the year.

Harvard Step Test

Student	Resting pulse pre	Resting pulse post	1-1/2 after test pre	1-1/2 after test post	2-1/2 after test pre	2-1/2 after test post	3-1/2 after test pre	3-1/2 after test post	Physical Fitness score pre	Physical Fitness score post
Experimental	61	64	120	128	108	120	100	108	46	42
	94	89	120	112	112	100	96	96	47	49
	88	76	128	108	108	100	96	96	45	48
	80	84	134	128	112	120	108	104	42	43
	64	53	132	124	120	112	112	100	40	45
	95	88	132	128	136	120	120	116	39	41
	60	72	140	104	116	100	124	84	39	52
	80	88	144	132	136	120	128	120	37	40
	88	88	148	136	144	124	128	120	36	39
	720	702					1012	944	371	399
Average	80	78					112.4	104.9	41.2	44.3
% Improvement		2 1/2%						7%		8%
Control	68	70	116	112	100	104	88	100	49	47
	64	80	120	120	108	112	100	108	45	44
	70	64	124	112	112	100	96	100	45	48
	78	74	136	120	120	104	110	96	41	47
	90	85	128	128	124	124	120	116	40	41
	72	84	136	140	128	128	120	120	39	39
	74	92	142	136	128	132	118	120	39	39
	96	80	140	144	140	120	132	120	36	39
	76	68	164	144	152	124	136	116	33	39
	688	697					1020	996	367	383
Average	76.4	77.4					113.3	110.6	40.7	42.5
% Improvement		1%						2%		4%

A Comparison of Physical Fitness Tests
Before and After Spats and Vests

	pre-test sit	post test	pre-test	post test	pre test	post test	pre test stand. broad jump	post test	pre test 50 yard dash	post test	pre test softball throw	post test	pre test 600	post test
Experimental Group	36	99	4	9	9.8	9.6	6'4"	6'8"	7.2	6.5	148'	163'6"	1:42	1:32
	49	99	5	9	10.2	10.1	6'5"	6'6"	7.4	7.4	146'	153'	1:54	1:40
	50	99	2	7	10.7	10.1	5'11"	6'9"	7.6	7.0	196'	206'	1:51	1:40
	50	99	3	6	10.6	9.3	6'4"	7'0"	7.5	7.1	145	154'	1:51	1:41
	52	92	6	13	10.2	9.5	6'6"	7'5"	7.2	6.8	168	195	1:48	1:32
	99	99	7	14	10.7	9.9	6'3"	7'3"	7.6	7.3	157	165	1:49	1:36
	99	99	2	6	10.5	10.0	5'6"	6'10"	7.8	7.6	123	133	1:57	1:52
					72.7	68.5	43'3"	48'5"	52.3	49.7			12:52	11:33
Average					10.4	9.8	6'2"	6'11"	7.5	7.1			1:50	1:39
% of Improvement						6%		12%		6%				11%
Control Group	70	99	5	12	10.9	10.2	5'10"	6'6"	7.2	6.9	178'	169'	1:55	1:47
	38	66	2	10	10.2	9.8	6'5"	7'3"	7.2	7.2	198	184	2:04	2:02
	51	99	6	18	11.0	10.2	6'4"	7'3"	7.6	7.4	156	148	1:47	1:40
	63	99	5	12	10.2	9.5	6'3"	7'2"	6.9	6.8	143	170	1:55	1:44
	33	99	8	16	9.5	9.4	7'1"	7'6"	6.9	7.1	159	141	1:49	1:45
	81	99	5	11	9.8	9.5	7'4"	8'0"	7.0	6.7	159	146	1:41	1:36
					61.6	58.6	39'3"	43'8"	42.8	42.1			11:11	10:34
Average					10.3	9.8	6'7"	7'3"	7.1	7.0			1:52	1:46
% of Improvement						5%		10%		1%				6%

PROJECT TITLE The Improvement of Efficiency of Communications in the Mathematics Classroom

Glen Luchau, Marvin Karlin

PRELIMINARY STATEMENT

The study of mathematics is a study of abstractions. Though a mathematician uses an abundance of symbols and diagrams, he teaches in a way which assists the student in acquiring concepts, generalizations, and transfer of knowledge.

In times past, the teaching of mathematics was attempted largely through rote, drill and memory exercises. And as a result, mathematics has been regarded as something contained only in the minds of mathematicians and textbooks. Communications in mathematics classes have too often failed to produce the desired changes in a student's thinking, attitude, and participation.

Today, however, we realize we must teach students more mathematics than before, and that this must be accomplished with more understanding than before. And though the mass of information to be communicated from teacher to student has increased, the length of time given to this communication in many cases has remained fixed - or has even been decreased to make room for new subjects or activities. Therefore, the need for higher communications efficiency in mathematics classes presses itself to the fore.

One of the reasons for the communication failure is that we have placed too much emphasis on words. We tell the student, we provide him with written work, we try to teach him new words. But the overuse or exclusive use of words results in verbalism and forgetting. Students easily adopt words or phrases without considering what they mean. They easily forget because they do not use the new knowledge or at least do not perceive a use for it.

On the other hand, a study such as science is often times more attractive to students than mathematics. They have more opportunity to see material uses for the knowledge they gain there. They have objects they can handle; they have pictures that show them things to learn. Some of the groups that have been formed to revitalize the mathematics curriculum have, by and large, only increased the number of words to be juggled in the mathematics class.

It is my belief that even though mathematics deals with abstractions, there are many things to show a student. Science need not steal the show. Mathematics, also, can be dramatic for better communications.

We can talk about ideas, but when we show a picture or a pattern, then we have opened other avenues for communicating ideas. Words can carry meaning to a person only when he can give them meaning.

Therefore I proposed that the use of visual materials that could be quickly and easily handled in the classroom would greatly increase the communication efficiency in the mathematics classroom. Such materials would supplement and complement words used, thus clarifying concepts and generalizations and also freeing time from tedious explanation and repetition for further pursuits.

There are available commercially a limited number of objects and models illustrating an even more limited number of principles in mathematics. The visual materials I proposed were not of this same nature. The materials I had in mind were simply two dimensional "pictures." For example: A sequence of mathematical sentences or expressions can be written on a chalkboard for display - but many times teachers wish they were able to pick up the chaldboard marks and reorganize them to clarify certain concepts. If the same material were on transparent "overlays" and projected on a screen, the wished-for freedom would be realized.

The advantages of such materials are many:

-the precious time would not be wasted in copying and recopying material on the chalkboard.

-the student's attention would be continuously focused on the development of the concept.

-organization of ideas would be kept simple (no more overloaded chalkboards that look confusing!)

The basic plan was approved 11-1-61 as a two-year project; the first year to be used for collecting and preparing materials, the second year for the actual research and evaluation, conclusions, ramifications, etc.

STATEMENT OF THE PROBLEM

To teach more mathematics more effectively with the use of specially designed audio-visual devices designed to facilitate speed and depth of understanding.

Hypothesis

The use of visual materials in the mathematics classroom can greatly increase communications efficiency.

RESEARCH PROCEDURE

Patterns are to be emphasized.

Pictures, drawings, sequences of mathematical sentences, etc. are to be used in the development of concepts, in the discovery of generalizations, and in subsequent transfer from topic to topic. An overhead projector for most visual materials will be used. A flannel board will be used for "cut-outs."

Both "static" and "dynamic" projectuals will be employed.

Besides the standard screen, three chalkboard surfaces; plain, lattice plane, real coordinate plane, will be used to receive projected images and/or for use with colored chalks.

All materials will be prepared by the teacher for use in 7th grade SMSG math and 9th grade UICSM algebra classes.

FORM OF EVALUATION

1. An overhead projector was purchased (and a screen built). The model chosen was low in design and operated from the front. The screen was mounted above the regular chalkboard in front of the class. The teacher can stand or sit at the desk and face the class while operating the projector. The projector is kept in position as part of the classroom furniture so that no class time is wasted setting it up.

2. Films were purchased and printing-development equipment was built. The film process is simple and does not require a dark room nor elaborate equipment. (That used in this project cost approximately $15).

3. "Projectuals" (finished film) to be used in the project were begun. All materials are being designed and made by the teacher conducting the project.

About 20 of the permanent projectuals that were prepared will be used in the research part of the project the second year. An undetermined number of uses of the projector were made in the classroom during the year to determine what other permanent projectuals could be designed. A description of each one used will accompany the final report of this project.

CONCLUSIONS

Though it was not intended to prepare an evaluation of the project the first year, these things stand out:

1. When the overhead projector was used, less class time was used to present a new topic compared to the time that had been used by this teacher the preceding year without the use of the projector.

2. The project was outlined and the projector demonstrated at a meeting of math teachers. It was received with enthusiasm. As a result of that demonstration more than a dozen of the finished projectuals are being duplicated in quantity for those teachers.

3. Seventh grade students were asked to write their own (subjective) evaluation of the use of the projector in the math classroom.
Typical statements are:

> I think I learned a lot from it. It's more interesting with the machine than just telling about something. I think it should be used more to teach us.
>
> ...when you first read about something you must make a picture of your own in your mind and often this picture is the exact opposite of what the teacher really wants the student to see.
>
> I think that using the projector has helped me to learn faster.
>
> The students pay more attention when we are looking at that machine than when using the blackboard. It's in a place where it can be seen very easily a lot better than the blackboard.
>
> It seems easier to learn when you have a picture in your mind from the image on the screen.
>
> It helps people understand better than just having a teacher up in front of the class trying to explain it.
>
> It is a good way to introduce new things and get them straight from the start.

> ...you can work with it better than a blackboard. The class can see it better than the blackboard. (the screen)

Many students suggested that the use of these materials be extended to other classes (geography and language arts were mentioned often.) Most students suggested that the projector be used more often.

PROJECT TITLE The Effect of an Individualized Paperback Program in English on Reading Skills and Appreciation in the Ninth Grade

James Quinn, Vernon Smith

STATEMENT OF THE PROBLEM

To determine whether a controlled paperback reading program in junior high is a more adequate tool than the presently used anthologies for teaching reading, literature, and grammar.

RESEARCH PROCEDURE

This experiment was performed with two average ninth grade classes and one improvement section in English.

The 2nd hour class (typical) used the traditional anthologies, while the 3rd and 4th hour sections (average) used paperback materials. Additionally, the 4th hour class also used a paperback grammar handbook to supplement the regular text.

A total of 68 students participated in the project, and approximately nine weeks were used in evaluating and testing the experiment.

Instructional techniques included panel discussions, individual reports, and teacher-directed classroom discussions.

FORM OF EVALUATION

The ITED (#3, #7, #8) tests were used which measured Expression, Literature, and Vocabulary and disparity between the pre and post scores on each test.

CONCLUSIONS

Test data indicated that there was no significant difference in scores between pre and post tests in classes engaged in use of paperback books and those classes who used the regular anthologies.

Implications

The validity of this paperback project appears evident in the increase in test scores, general improvement within all three areas, and basic satisfaction as measured by the student opinionnaire given at the end of the nine week consideration.

Allowances, of course, should be made for individuals within the classes (low I. Q. 's academic abilities, etc.), but there is an interesting increase in the area of vocabulary, throughout the classes. Particular attention should be given to the 4th hour class who used paperback books in both grammar and literature. In this section it appears the materials provided for individual differences in all test areas, and increased post-test scores.

With such material it is possible to effect why-wherefore, motivational questions in the classroom, to offer a greater variety of materials to the student, to attract and challenge the student.

Certainly changes beneficial to the utilization of each unit will be made as teachers learn more about the program. It is good that such a program forces a teacher to anticipate a block of work long in advance.

PROJECT TITLE Follow-up Study of 1960-61 Graduates

Mabel Bolitho, Thomas Brown, Hazel Nolan, Robert Stapp, Marjorie Thomson, Fred Dyer

STATEMENT OF THE PROBLEM

In order to have the benefit of thinking of graduates of the R-1 schools in relation to their school experiences, the guidance and counseling office is currently conducting a follow-up study of 1960 graduates from each of the eight Jefferson County high schools. The purposes of this study are:

A. To determine what positions the 1960 graduates of the eight Jefferson County high schools presently occupy.

B. To determine if there is a similarity or difference of the post high school experiences of the graduates of the eight high schools.

C. To determine if the present high school counseling and guidance services are, in the opinion of graduates, fully meeting the future needs of the graduates.

D. To determine if there are implications of this study that may be used in an evaluation of the present high school curriculum.

RESEARCH PROCEDURE

A. A self-addressed double post card questionnaire was sent to each of the 1960 graduates.

B. There were 1,234 students involved in this study.

C. The first set of post cards were sent to the students in April, 1962. It will be at least late July or early August before all results are reported to the office of guidance and counseling.

D. The guidance and counseling office is currently sending a second post card questionnaire to the 1960 graduates who did not reply to the first request. The following is a percentage of the return of questionnaires from each of the eight high schools as of June 20, 1962.

PRELIMINARY DATA

The following is the percentage of return of the post card questionnaires sent to the graduates of the eight high schools of the class of 1960 as of June 20, 1962:

SCHOOL	NUMBER OF STUDENTS	NUMBER RETURNED	PERCENTAGE
Alameda	98	48	48.9
Arvada	199	98	49.2
Bear Creek	80	34	42.5
Evergreen	48	28	58.3
Golden	163	70	42.9
Jefferson	94	47	50.0
Lakewood	266	123	46.3
Wheat Ridge	276	137	49.6
TOTAL	1,234	585	47.4

At this point in the study the following reactions are noted to the questionnaire questions:

I. Check if you are single or married.

	NUMBER OF RETURNS	NUMBER SINGLE	PERCENTAGE	NUMBER MARRIED	PERCENTAGE
Male	280	252	90.0	28	10.0
Female	305	221	72.5	84	27.5
TOTAL	585	473	80.9	112	19.1

II. Check if you have been in military service.

NUMBER OF RETURNS		NO. IN SERVICE	PERCENTAGE	NO. NOT IN SERVICE	PERCENTAGE
Male	280	28	10.0	252	90.0
Female	305	1	0.3	304	99.7
TOTAL	585	29	4.9	556	95.1

III. Check if you have attained some type of education beyond high school.

NO. OF RETURNS		NUMBER OF YES'S	PERCENTAGE	NUMBER OF NO'S	PERCENTAGE
Male	280	248	88.6	32	11.4
Female	305	244	80.0	61	20.0
TOTAL	585	492	84.1	93	15.9

IV. Type of educational experience beyond high school.

NUMBER ATTENDING SCHOOL		4 YEAR COLLEGE	%	JR. COLLEGE	%	*OTHER	%
Male	248	186	75.0	27	10.9	35	14.1
Female	244	180	73.8	6	2.5	58	23.7
TOTAL	492	366	74.2	33	6.9	93	18.9

* Other in chart number IV would include any type of higher education experience that a student would have in lieu of a four year college or junior college program, such as technical school, barber school, business school, adult education, nurses training not leading to a degree, etc.

After the final data for this study is collected the institutions of higher learning will be listed by name and location.

V. Please name your current occupation.

Of the 585 returns received to date there has been a listing of over fifty different occupations. More than 70 percent replys have indicated student for their occupation. Later in this study these various occupations will be listed according to job categories.

VI. Please indicate your plans for 1963.

	NO. OF RETURNS	STUDENT	PERCENTAGE	MILITARY SERVICE	PERCENTAGE
Male	280	181	64.6	28	10.0
Female	305	140	45.9	1	0.3
TOTAL	585	321	54.8	29	4.9

	CONTINUE PRESENT WORK	PERCENTAGE	FIND NEW WORK	PERCENTAGE
Male	29	10.4	11	3.8
Female	39	12.8	18	5.9
TOTAL	68	11.6	29	4.9

	UNCERTAIN	PERCENTAGE	TRAVEL	PERCENTAGE	HOUSEWIFE OR MARRIAGE	PERCENTAGE
Male	28	10.0	0	0.0	3	1.2
Female	47	15.4	2	0.7	58	19.0
TOTAL	75	12.8	2	0.6	61	10.4

VII. If you took advantage of the services available how would you rate your high school preparation?

	NUMBER OF RETURNS	GOOD	PERCENTAGE	FAIR	PERCENTAGE	POOR	PERCENTAGE
Male	280	136	48.6	128	45.7	16	5.7
Female	305	180	59.0	109	35.7	16	5.3
TOTAL	585	316	54.0	237	40.5	32	5.5

VIII. Was your high school counseling adequate?

	NUMBER OF RETURNS	YES	PERCENTAGE	NO	PERCENTAGE
Male	280	179	63.9	101	36.1
Female	305	199	65.2	106	34.8
TOTAL	585	378	64.6	207	35.4

The final report will also contain the write in comments of students that have added to the validity of the study.

PROJECT TITLE Experimental Study of the Professional Reader in Secondary School English

Charlotte Collins, Billie Edmundson, Don Gill
Vernon Smith

STATEMENT OF THE PROBLEM

The purpose of this project was to determine whether students in research group whose compositions were read and evaluated by a professional reader showed significant improvement in composition work compared to the work of the control groups. These readers would be fully certified teachers of English.

RESEARCH PROCEDURE

Approximately one hundred students participated in the experimental group, and approximately 164 students served in the control group. The time span covered eighteen weeks including pre and post testing. The experimental group wrote a theme a week, but the control group continued with a normal course. The former group corrected the errors marked by the reader and returned the corrected themes for rechecking to their regular teacher, thus improving their writing ability to the utmost. The themes were called for by the reader on a certain day and returned the following day, therefore increasing the effectiveness of the writing assignment.

FORM OF EVALUATION

The Sequential Test of Educational Progress in Writing was administered to both experimental and control groups. The experimental group under each teacher showed a greater gain than the control groups under the same teacher.

CONCLUSIONS

We are very favorably inclined toward this program with some modifications. We propose that each English teacher should have a reader assigned to him. The program should specify the number of themes to be graded by the reader, but the teacher should be allowed some discretion regarding the days upon which an assignment should be written. We feel the anonymity of the reader is a distinct advantage; however, the most desirable situation would be the reduction of the number of students in each English class and the reduction in number of classes per English teacher per day.

PROJECT TITLE Fles Non Fles Research

Rafael Diaz, Paul McRill, Edward Tanguay

During the past few years many scholars and linguists have discussed the relative value of language learning in the elementary school. There have been conflicting opinions about the effects of such learning on success in the secondary school. Since no research has been accomplished to shed light on this question, it seems important to conduct an investigation into the matter.

STATEMENT OF THE PROBLEM

To determine the extent to which foreign language instruction in the elementary school contributes to achievement in foreign language learning in the secondary school.

Hypotheses

1. That three or more years of FLES training in a particular language significantly accelerates junior-high achievement in the same language.
2. That three or more years of FLES training in one foreign language significantly accelerates junior-high achievement in a different foreign language.
3. That three or more years of FLES training contributes significantly to achievement in other subject matter in the secondary school.

RESEARCH PROCEDURE

Tests in Spanish and French were developed by two language teachers and Supervisor of Foreign Language with consultative help from Professor Arthur Campa and Professor George Scherer, of Denver University and Colorado University, respectively. These tests measure achievement in six areas of language skill -- aural comprehension, oral production, grammatical accuracy, pronunciation, reading comprehension and writing.

Since the major purpose of the research is to determine the affect of FLES study on subsequent work in foreign language, the student sample was selected to make comparison possible at the junior high level. Over a hundred students were selected for seventh grade testing -- about thirty in French and seventy in Spanish. The experimental and control groups were matched by IQ, sex and language. Control group students have had no elementary school work in foreign language; the experimental group students have all had at least three years of Spanish before grade seven.

The tests have been given in all schools currently involved -- Creighton, Lakewood, Wheat Ridge and Seventh Grade Junior High Schools. In these schools both experimental and control groups are in the same classes together, and are taught by the same nine teachers.

Master recordings for the tests were made by native speakers not engaged in teaching any of the students, and all tests were administered by Mr. Diaz and myself. All tests are being scored by at least two different persons who are not teachers of the students involved. I have scored both the Spanish and French tests; Mr. Diaz is separately scoring the Spanish; and Mr. Tanquay is re-scoring the French.

FORM OF EVALUATION

If the total scores on any test agree within twelve points, the differences will be averaged. In case of major disagreements, a test will be re-scored by a third expert. Of necessity, there is a strong subjective element in certain parts of the scoring, and this procedure is standard for reconciling differences in judgment.

Preliminary Report of Data

The mean total score for our experimental group (children who had Spanish in elementary school) is 40.6 percent. For the control group, the mean score is 31.9 percent. This gives the experimental group a general achievement advantage of more than 27 percent over the control group. When French is considered separately, the difference is even more striking, giving the experimental group an advantage of 38.8 percent over the control group.

In French only, preliminary breakdowns of scores have been made for eight different skill categories. The experimental group shows a significant advantage in all categories except "aural comprehension." Here the difference in achievement is only slightly in their favor.

Even at this point of data analysis, it seems safe to conclude that foreign language works in junior high school is accelerated perceptively by a previous FLES program. This is apparently true, even when a different language is undertaken in the secondary school. It remains for the testing of subsequent years to determine how far into the upper grades this advantage extends, and to what extent.

PROJECT TITLE Replacement of English Textbooks by Paperbound Books for College Bound Seniors and Selected Juniors

Janice Corrick, Charles McLain

STATEMENT OF THE PROBLEM

To determine if the replacement of current literature anthologies and grammar textbooks by selected paperbound books would more effectively prepare college bound seniors and selected juniors in correctness of writing, literary interpretation, and writing compositions.

Hypothesis

The traditional literature anthology, which lacks in complete works and freedom of choice, could be more effectively replaced by selected paperbound books, which would enable the teacher to choose fewer, more significant works which could be critically studied in depth. The end results would demand a better prepared teacher and produce a critical, articulate student.

RESEARCH PROCEDURES

Particular Instructional Techniques Used

The experimental groups involved three sections of English IV College Preparatory and two English III sections, which were taught by paperbound books. These groups studied an essay collection, a poetry collection, a short story collection, one drama, and two novels. Strunk and White's The Elements of Style served as the grammar text. In addition, these groups had twenty-eight novels for choice in the individual reading and study program. Question guides were used as the basis for study. This was supplemented by class discussion, in-class and out-of-class compositions written on the material read, and essay tests over major units of work.

The control groups involved two English IV College Prep. and one English III section, which were taught by the traditional grammar textbook and literature anthology method.

Numbers of Students Involved

Ninety-one English IV and fifty-two English III students were involved in the experimental groups. Forty-eight English IV and thirty English III students composed the control groups.

Other Pertinent Factors Peculiar to the Project

In the individual reading program students had no pre-set number of books to read, but read at their own rate and on their own level. The number of books read ranged from two to thirteen.

Teachers had more time for individual conferences about the reading and composition phases of the program.

FORM OF EVALUATION

Standardized Test Results - Pre and Post Experiment

Test three (Correctness of Writing), test seven (Literary Interpretation), and test eight (Vocabulary) of the Iowa Test of Educational Development (ITED) were given at the beginning and close of the experiment.

The following tables are the results of the comparison of the pre and post experiment raw test scores:

English IV - Experimental Groups
(Potential 90 students)

Test	3	7	8
Gain	32 (35.6)	53 (65.4)	60 (73.2)
Same	15 (16.6)	13 (16.0)	11 (13.4)
Loss	43 (47.8)	15 (18.6)	11 (13.4)

English IV - Control Groups
(Potential 48 students)

Test	3	7	8
Gain	15 (35.7)	20 (51.3)	26 (61.9)
Same	8 (19.0)	4 (10.3)	9 (21.4)
Loss	19 (45.2)	15 (38.4)	7 (16.7)

English III - Experimental Groups
(Potential 52 students)

Test	3	7	8
Gain	20 (38.5)	25 (50.0)	40 (80.0)
Same	5 (4.6)	11 (22.0)	2 (4.0)
Loss	27 (51.9)	14 (28.0)	8 (16.0)

English III - Control Group
(Potential 30 students)

Test	3	7	8
Gain	8 (26.7)	15 (53.6)	25 (86.2)
Same	4 (13.3)	5 (17.8)	3 (10.3)
Loss	18 (60.0)	8 (28.6)	1 (3.5)

Specifically Constructed Tests - Pre and Post Experiment

The students wrote in-class compositions at the beginning and at the end of the experiment. The identity of the teacher, group, writer, and time of the writing was concealed. These compositions were marked A, B, C, D, F, by a reader outside the experiment.

The following tables are the results of the comparison of the grades on the pre and post experiment compositions:

English IV - Experiment Groups

Gain	29 (35.8)
Same	26 (32.1)
Loss	26 (32.1)
	81

English IV Control Groups

Gain	16 (37.2)
Same	19 (44.2)
Loss	8 (18.6)
	43

English III - Experimental Groups

Gain	12 (27.3)
Same	17 (38.6)
Loss	15 (34.1
	44

English III - Control Group

Gain	12 (42.9
Same	7 (25.0)
Loss	9 (32.1)
	28

CONCLUSIONS

A. Conclusions based on test data
   1. On the basis of test three of the ITED test neither the experimental nor the control groups showed any significant change.
   2. On the basis of test seven (ITED) all senior groups showed significant improvement except the hour four senior control group which showed a loss. Experimental groups showed a more significant gain.
   3. Test eight (ITED) revealed an even greater improvement in both the experimental and control groups than in test seven. The gain seems more significant in the senior classes than in the junior classes.
   4. The composition test revealed no significant change.

B. Conclusions based on subjective observations.
   1. Students in the experimental groups read substantially more this year than students in the control groups.
   2. Students in the experimental groups strongly favored the reading program with the exception of three students.
   3. In 1E and 2E the students felt that grammar and composition needed more emphasis.
   4. Students in the experimental groups felt they learned more about how to read.
   5. In 3E the students felt that grammar and composition were covered sufficiently.
   6. Senior students, if given the opportunity, would choose to participate in the paperback program next year.

7. Junior reaction was highly favorable in the experimental groups, but not as favorable in the control group.
8. Senior students were almost unanimous in their enjoyment of the paperback program. (Two were uncertain.)
9. A large majority of the students expressed the feeling that they had learned more about reading and literature.
10. In 1E and 2E the students indicated that they had not learned more about grammar and composition.
11. In 3E a significant number of students felt they had learned more about grammar and composition.
12. Senior students involved in the experimental groups had almost without exception a positive attitude toward the paperback program.
13. Seniors in the control group expressed the same positive attitude.

Ramifications

A. Curriculum implications

1. Extremely high interest on the part of the students, and the significant test results indicate that this experiment merits continued study.
2. The high interest on the part of the students represents a challenge to the teachers involved.
3. Based on the test data and the opinionnaire results, a new approach to teaching grammar and composition is indicated.
4. Because of the variance of reading speed, reading ability, and reading interests, teachers may prefer to organize programming to emphasize independent study by students.
5. Because of the wealth of reading material offered in this program, it is the opinion of the teachers involved in this experiment that only teachers with extensive reading backgrounds would be qualified to administer this program.
6. Organization of a program of this type would depend upon individual school needs.
7. This program seems more effective for mature advanced juniors than for the average and low juniors.
8. At the senior level the greatest gains occurred among the average students.
9. The gains made among advanced seniors, although significant, were in the abstract areas (reasoning, analysis, critical thinking).
10. Teachers can use more flexibility in programming with the paperback program.

11. The variety of material studied seems to sustain student interest longer than in the traditional classes.
12. The wide variety of fiction available allows each student to read at his own level of achievement and in his own area of interest. Thus, slow readers do not feel as keenly the pressure of keeping up with the more rapid readers.

Next Steps

1. The paperback program is being implemented in all sections of English IV College Prep. at Lakewood High School.
2. We recommend additional research in the following areas:
    a. The follow-up study of 1962 graduates to determine any or what effect the experiment will have on their performance in college.
    b. Questionnaire to determine parental and teacher reaction to the study.
3. Next year's program will be designed to encourage students to study independently.

Questions for Discussion

Differentiate between the individual and society.
Explain what is meant by man's potential.
What is an individual's obligation to society?
What is society's obligation to the individual?
What is the individual's obligation to himself?
What is man's capacity for objective personal assessment?

The Assignment

Write a composition on the following subject:

THE FINE LINE BETWEEN INTELLECTUAL RESPONSIBILITY AND SOCIAL DUTY.

Instructions to students:

1. Thirty minutes will be allowed for the composition, not including instructions. Use ink only.

2. Your theme will be turned in before the end of the period. It should be about one page in length (one side only). It may be a little shorter but no longer than one page.

3. The instructor will tell you when you have ten minutes left so that you will have time to make revisions and recopy your paper if you wish.

4. Each of you will be given two sheets of paper. Do not write anything until the instructor gives the directions.

5. On one of these sheets, endorse your paper according to the instructor's wishes. (Include name, date and section).

6. The second sheet may be used for scratch paper or rough draft. Both sheets will be collected at the end of the thirty minutes.

7. Be sure that your final copy includes a title and the proper endorsement. Skip two lines between the title and the first line of the composition. Do not skip lines in the body of the paper.

PROJECT TITLE Use of Syllable Ladders in Music Instruction

E'Rena Hockenberry, Joseph Perito

STATEMENT OF THE PROBLEM

To develop syllable ladders as an approach to bring about better understanding and learning among students in a unit presently contained in the Jefferson County music program.

Hypothesis

The ear in music must be trained first. After students know the sounds of the intervals, the eye can take over for the development of the sight reading program. The ear training process is a matter of drill. If the drill is interesting or stimulating to the students, it ceases to be drill in their minds. A change each month of the figures or the symbols plus liberal use of color will stimulate greater interest in participation and understanding in the learning of syllables.

RESEARCH PROCEDURE

The basic approach would be to develop a syllable ladder for each month of the school year, using colored symbols or figures to indicate a holiday or season normally identified with that particular month; as in October, witches, black cats, or owls; February, hearts, hatchets, or cherry trees, etc. Numbers one through eight would be placed beside the figures, the syllable names on the figures. The tonic (or I) chord would be of a different color or shape than the other figures on the ladder. The figures would be affixed to the ladder to indicate whole and half steps in the scale. The researcher would use two ladders for each month, one for the major scale and one for the minor scale. The syllable ladders would be valuable for the ear training program for our students.

Investigation could be carried on in two schools, using one school for syllable training done with chalk and blackboard and the other school using the colored symbol ladder. This approach could be carried out by the author of this research proposal who is assigned two different elementary schools in Jefferson County.

FORM OF EVALUATION

A study questionnaire would be composed in conjunction with the Supervisor of Music Education and the Director of Research, which would seek out answers to the way in which students viewed syllable learning and what emphasis they placed on the use of color and symbols in learning. In addition, an outside music expert would be brought into the district from a nearby college or university to make a trained assessment of the relative abilities of the research and control groups, concerning enthusiasm, depth of learning and competence.

Progress Report

It has consumed more time than originally conceived to plan and construct imaginative syllable ladders. The major portion of the second semester was devoted to this purpose.

Now that the instructional aids are perfected it has been requested that I be allow to pursue the actual research involved in the use of the aids during the entire 1962-63 school year.

PROJECT TITLE Instructional Aid Development in Teaching Symphony Instrument Identification

E'Rena Hockenberry
Joseph Perito

STATEMENT OF THE PROBLEM

This research undertaking attempted to increase the understanding and the rate of acquisition of knowledge by students concerning the identification of instruments of the symphony orchestra and its families through the use of specially designed teaching aids. It was felt that any teaching aid which makes learning easier and more interesting for students was worthwhile and justified the time and attention of the teacher in the development of such materials.

RESEARCH PROCEDURE

Two schools in which the researcher is a music teacher were selected for this research. In both instances improvement classes were selected because as a general rule it is more difficult for these students to acquire academic competence and skills. One class was used as a research class, the other as a control class. The factors involved in the research approach are listed below:

1. Both groups were taught in exactly the same manner, with pictures, lectures demonstrations, and records, except that the instructional aids developed were utilized in the research group. The culminating activity was listening to a symphony concert by the Denver Symphony Orchestra.

2. In the research class the instructional aids were used for ten minutes of classroom instruction on four separate occasions. The materials were left in the home room between classes so that the students could work with them individually or in small groups.

3. In the control class the teacher used movies, pictures, and records for added instruction. The source of most of this material was the Bowmar Records and Meet the Instrument Series.

4. At the conclusion of this first instruction period, a written test devised by the teacher was administered to both groups. The test used and the scores attained are included with this report.

FORM OF EVALUATION

Pre and post testing of research and control groups with teacher constructed test. Fifty- two students participated in the first testing session, fifty-one students participated in the second testing session.

CONCLUSIONS

It is obvious that the instructional aids developed in this research need to be used over a more extensive period of time before sound conclusions may be drawn. However, on the basis of the limited time these aids were used during the present school year it would appear that they have merit in facilitating learning. The test data reveals an interesting, if not yet significant, difference in results in the gain made in pre and post test of the research groups as compared with the pre and post testing gain in the control group. This research will be continued on a more extensive basis during the forthcoming school year.

Evaluation of Fels Foundation Project

SLATER SCHOOL				COLUMBIA HEIGHTS SCHOOL			
Instruction Without Use of Project				Instruction With use of Project Between Test 1 and Test 2			
Possible Score	Per Cent Correct	Test 1 No. of children	Test 2 No. of children	Possible Score	Per Cent Correct	Test 1 No. of children	Test 2 No. of children
36	100	1	1	36	100	1	7
35	97	0	1	35	97	3	1
34	94	1	2	34	94	0	3
33	91	5	3	33	91	1	3
32	89	2	2	32	89	2	0
31	86	1	4	31	86	1	2
30	83	2	1	30	83	2	4
29	80	2	2	29	80	1	1
28	78	3	0	28	78	2	1
27	75	2	3	27	75	1	1
26	72	0	2	26	72	0	0
25	69	3	0	25	69	1	0
24	66	0	0	24	66	2	0
23	64	0	1	23	64	1	0
22	61	1	1	22	61	2	0
21	58	0	0	21	58	2	0
20	56	0	0	20	56	2	0
19	53	0	1	19	53	0	0
18	50	1	0	18	50	2	2
17	48	0	0	17	48	0	0
16	44	2	0				
15	41	0	0				
14	38	0	2				
Totals		26	26			26	25
Average Score		28.1 78%	28.4 78.7%	Average Score		26.8 74.5%	31.6 87.6%
Mean Score		28	30	Mean Score		27	33
Median Score		29	30	Median Score		27	31

Instruments of the Orchestra

String family______No. 1

Woodwind family ______No. 2

Brass family____No. 3

Percussion family ____No. 4

1. Violin__________
2. Trumpet_________
3. Tympani or kettle drum_________
4. French Horn__________
5. Tuba_________
6. Viola_________
7. Cello_________
8. Castanets________
9. Bass Drum________
10. Bass Clarinet_________
11. Bells_______
12. Glockenspiel__________
13. Flute_________
14. Piccolo_________
15. Triangle__________

18. Bass Viol_____________
19. Harp____________
20. Snare Drum__________
21. Gong__________
22. Celeste__________
23. Xylophone__________
24. Oboe__________
25. English Horn__________
26. Cymbal__________
27. Bassoon__________
28. Marimba__________
29. Contrabasoon__________
30. Maracas__________
31. Saxaphone family__________
32. Tambourine___________

16. Trombone____

33. What does Arco mean?____________________________
34. What family in the orchestra uses this term?_____________
35. What does Pizzicato mean?_______________
36. What does percussion mean?_____________

PROJECT TITLE An Investigation of Two Instructional Approaches Designed to Increase Ear Familiarity in a Music Appreciation Program

Robert E. Wilson
Joseph Perito

STATEMENT OF THE PROBLEM

This study was designed to assist in determining which of two methods would bring about the greatest degree of ear familiarity as evidenced by the students ability to recognize a particular composition and its composer immediately after listening to a selection.

RESEARCH PROCEDURE

The plan for carrying out the study was as follows. The research population consisted of four sections of students at Maple Grove School. The students were not grouped homogeneously, but were very similar in range of ability. Two sections will be referred to as Group I and two sections will be referred to as Group II.

A pre-test in Music Appreciation was administered to all students. The list of selections and composers was prepared on a master sheet and duplicated so that each student would have a copy. The selections were played and the students asked to number the selections in the order in which they were played. Obviously selections had to be chosen on the basis of their unfamiliarity to the groups. Therefore, a pre-test was administered to determine the selections with which the students were familiar. This test involved selections chosen from our own school library.

Group I received only the name of selection and composer plus the same amount of listening time as Group II. Group II received a detailed study of the life of composer and the structure of the compositions plus the same amount of listening as Group I.

The groups met once a week in the regular classroom schedule for one semester. Each group met the same number of times.

A final test was administered to both groups to determine whether or not Group I which received only listening had as great an ear familiarity with the selections played as those who had the background of the composer and the structure of composition.

The classroom teachers administered all tests and materials necessary to the study. The tests and materials for instruction were prepared by the vocal music instructor.

FORM OF EVALUATION

This program had a few drawbacks, but all concerned are willing to try to overcome these hurdles and try again next year.

One of our major problems was that a volunteer chorus was scheduled for the same period that the Music Appreciation class met. It is the feeling of the classroom teachers that the students who did not join chorus were not interested in music. As a result the students taking the Music Appreciation Program felt that this was punishment for not joining chorus.

The majority of students in this program were boys. Group I had 15 students - 13 boys and 2 girls. Group II had 22 students - 19 boys and 3 girls.

The study ran for a total of 14 weeks. The students met once a week for a period of 25 minutes per session.

The students in Group I had a tendency to become bored by just pure listening. The interest in Group II was relatively high because of the story of the composer and the structure of his works. The classroom teachers were enthusiastic about the program. They would like to see it continued next year.

The tests were constructed by the vocal music instructor. The selections were taken from the school library. There were two tests A and B. Each test had seven selections. The same tests were given at the end of the study as were given at the start of the study.

Group II did not show that they had a greater ear familiarity to identify the selections than did Group I. Both groups scored the same on the final test as they scored on the pre-test.

CONCLUSIONS

The conclusion from this study is that meeting once a week and hearing the selection once is not enough to establish ear familiarity.

We would like to continue this study next year. A recommendation for next year would be to play the selection twice a week. The 25 minute period seemed to be about the right length for listening. It has also been recommended to use the entire class instead of just a few students from each section.

PROJECT TITLE The Use of A Daily Newspaper as a Basic Grammar and Literature Text

Carolyn Wolf
Vernon Smith

STATEMENT OF THE PROBLEM

According to Dr. James Conant, "The minimum goal for almost all pupils at the end of grade 9 is that these future voters should be able to read with comprehension the front of a newspaper at a rate of about 200 words a minute." This project was designed to determine if the use of the New York Times as a basic grammar text and literature anthology would have any noticeable affect on the English skills of a designated group of ninth grade students.

RESEARCH PROCEDURE

A. Instructional techniques used:

1. Introduction to the newspaper

a. Reading a news article involves similar skills used in reading a short story, as meaning is the most important attribute. A class discussion was held after reading a story to decide which facts were more important. In class the conclusion was reached that the most important facts in a news article were found in the first paragraphs. This was the desired objective.

b. Finding the basic needs of a news story was discussed next. I lectured on the use of the 5 W's and H of a news article. The lecture was followed by exercises in locating these points of a news story, where the students underlined these facts in a story they read.

c. The use of headlines was discussed with the students concluding that they are used to identify stories and interest readers in the articles.

d. Reading stories for continuity was introduced by having students read an article about which they knew very little. The questions which they had about the story were discussed. The next day the students read a further article on the same subject. The questions which the students had were less, bringing them to the conclusion that some articles must be followed from day to day to be completely understood. In this manner the class realized that all news stories do not answer all of the needed questions every day because reporters assume some of the questions' answers will be understood by the readers when they follow the stories from day to day.

e. The different types of news articles were introduced by lecture. The news story was briefly discussed and the feature story and editorial were discussed in more detail, as no previous work had been done on them. The requirements and purposes of each type of article was discussed with reading and analysis of each type in class. Time was spent finding the different sections of the newspaper and working with the index.

f. Early in the semester timed readings were used to increase speed of reading a news story and to increase comprehension of the article. The reading was held for two minutes, with a mark made at the end of the first minute. Words between the first and second minute were counted and a short quiz was held to determine comprehension. The students showed some progress in their speed and comprehension.

2. Grammar unit of simple, compound, and complex sentences.

    a. The different types of sentences were introduced with simple forms on the broad and more difficult ones in the newspapers.

    b. The newspaper was used for drill. Students read stories and labeled the sentences in the stories. Students also had practice in differentiating sentences through the writing of their own sentences.

    c. From the results of the test showed that good students could learn the grammar in this manner. However, it was very difficult for the poor student.

3. The newspaper provides ample material for vocabulary study, as many of the words are unknown to the students. In class students selected one word a day which they did not know. At the end of the week ten words were selected by the class to be learned; a test was given over these words.

4. For composition the students wrote news articles, features, and editorials, using either events from school or events from the newspapers. The stories which the students felt were best were included in a class newspaper, along with advertisements which they wrote. The students typed the ditto masters and ran the papers off themselves, so that the entire production was their own work.

5. The semester work ended with a unit on public opinion and propaganda. At first the class studied methods of developing public opinion. Then the class

discussed propaganda devices. They looked for devices in the newspapers. Then using a supplementary issue from the New York Times we switched cartoons favoring the United States to favor the Soviet Union. In this way students could see how the same event may be used to favor either side of an issue. After this students selected an international problem to study. From this they wrote posters first to develop an opinion on their topic. Then they developed this opinion into an article written to persuade readers to their opinion. From these articles they gave speeches, also to persuade individuals to their view. In this manner the students had the opportunity to use the propaganda devices in different manners.

6. The students had one outside reading report, for which they could use one of the following forms: an advertisement, an editorial, a book review.

II. B. Number of students involved.

1. In experimental group -- 73

2. In control group -- 55

C. Time involved -- approximately one semester

FORM OF EVALUATION

The ITED tests were used to test the achievement of the students participating in the newspaper program. The test was administered at the beginning of the year and again at the end to judge the increase in learning throughout the year. Scores of the experimental and control groups were compared in the following test categories: Test 1, Social Studies background; Test 3, Correctness of Expression; Test 5, Social Studies reading; Test 7, Literature Reading; Test 8, Vocabulary; and composite score. The tests will be referred to from this point on by number.

For the most part the test scores were approximately equal, using the percentage of those having taken both tests whose scores increased, decreased, or evidenced no change as a basis. In Test 1 the experimental group showed an average increase among 57% of the students, a decrease among 41% of the students and no change among 2% of the students; the control group evidenced an increase among 53.5%, a decrease among 41.5% and no change among 5%. The difference is almost negligible on this test. Test 3 scores favored the control as this group tallied an increase among 61.5% whereas the experimental group gained only among 51.5% of the students. This difference resulted from more concentration in the use of correct pronouns in the control group than in the experimental groups. This area shows a lack in the information covered in the experimental groups, a lack which could be overcome through a more complete grammar unit using newspapers.

Test 5 scores displayed the opposite with the experimental group showing an increase among 59% of the students and the control groups showing an increase among 48.5%. In Test 7 the experimental groups gained among 78.5% of the students and the control groups among 66%. As both of these tests are reading tests, the scores indicate that the experimental students gained appreciably over the control groups in general reading ability. This, I believe, is the strongest point of the newspaper program. Although the program lasted but a short time, it definitely had a strong effect on the reading ability of the students involved. Important also is the fact that the newspaper program affects the reading ability of the students in more areas than merely literature.

Even though the reading ability of the experimental groups was improved, the vocabulary ability was not improved. While 62.5% of the experimental students increased their scores, 76.5% of the control groups increased their scores. This shows another weak point of the program, a point which should not be weak considering the numerous new words to be found in the New York Times. Vocabulary would be another area which should be improved if the program is to be attempted further.

This situation could be improved by a more concentrated program in vocabulary. A plan by which the teacher assigns the students an article a week in which to learn all unfamiliar words, according to their use in the story, would be my suggested procedure for improvement in this area. The students would be required to learn the spelling as well as the meaning for each word.

The composite scores show a slight gain for the experimental groups. The gain, however, is not substantial in my opinion. The experimental groups increased among 89.5% of the students and the control groups among 84.5% of the students.

CONCLUSIONS

A. Based on subjective observations

1. Students with higher ability or desire seem to gain more than students of lesser ability.
2. The New York Times, although it has excellent supplementary material, is at a higher reading level than most ninth grade students have achieved.
3. The New York Times is more suitable for students of advanced ability in the ninth grade or students in the tenth grade.

4. Although more difficult to teach, grammar has similar results with the newspaper as with the grammar text. This result was realized after a similar unit in types of sentences was taught to both classes. Generally the good students comprehend grammar, no matter how taught, and the poor students do not grasp it. ITED test scores may prove valuable on this point.

5. The time involved was not sufficient to complete plans for the course in newspapers.

6. Newspapers, although they provide excellent background material, should not be the total basis for the teaching of English. This conclusion I reached because the newspaper is only a part of the scope taken in by English. I believe it can lead students to develop a more critical awareness about their world and can encourage them to learn more of their world than the comic section of a newspaper. However, other media of English should be employed also. As far as the teaching of grammar, only a well-versed English teacher understanding of grammar a teacher would become hopelessly lost in the number of grammatical devices employed in the average newspaper. However, for the teaching of grammar, the newspaper provides a much more realistic approach to the problems of sentence structure.

V. Ramifications

A. Curriculum implications

1. A newspaper could be a valuable asset in a classroom, provided the teacher was equipped to handle such a program.

2. A weekly newspaper would be satisfactory for a year-long course using the paper, as one paper has sufficient information to last for that length of time. One aspect which would be lost by using a weekly publication would be the news continuity.

3. The newspaper could have useful effects in an English classroom because it provides realistic and contemporary material for English. The students can realize through such a program that there are necessary and important present-day needs for learning English skills.

4. A year's program would allow for greater corrolation of the newspaper to the English program, as outlined in the curriculum guide.

B. Next Steps

1. Trial of the newspaper in a year-long program. This is necessary for an adequate evaluation of the program.

2. For further experimentation, the use of a local paper might be explored. A local paper would emphasize problems of the community more than a paper based in another city. However, the use of supplementary materials from the newspaper would be limited by this as no paper from this area publishes school supplements to the extent of the New York Times.

3. A more complete unit in grammar should be attempted from the newspapers. A unit in verb study would be especially effective, as would one in the use of absolute phrases.

4. A unit in the comparison between news writing and creative writing would help develop a feeling for appropriateness of English for particular occasions.

The Future - Next Steps

In the view of large numbers of personnel in this school system the proposal to explore teacher potential for improving instruction classroom research has been a distinct success. We remain indebted to the Fels Foundation for their encouragement to pursue this idea and for the financial assistance in carrying it out.

The contributions of teacher initiated research proposals have made an impact on curriculum planning and content. Based on the findings of some of these research proposals curriculum content has been expanded, modified, or given new points of emphasis. The effect of this program on teacher morale has been both perceptible and gratifying. The quality of proposals and the competence of teachers in carrying them out has improved noticeably.

As a result of the last two years of opportunity to conduct small scale but meaningful research, the teaching staff of the Jefferson County Schools has been imbued with a higher regard for the profession and for their possible contributions to the advancement of that profession.

In the immediate future a proposal will be made to the Board of Education of the Jefferson County Public Schools. This proposal will outline the scope, number and kind of teacher research conducted during the past two years and will request the allocation of funds for the continuance of this program in the years ahead.